PUBLIC WORKS

Founded in 1896

Devoted to the interests of the engineers and technical officials of the cities, counties and states

VOL. 71. NO. 10

A. PRESCOTT FOLWELL, Editor

W. A. HARDENBERGH, Asso. Editor

Timewasters

The September Timewasters have created a stir and arguments, too. Well, according to the mortality statistics and tables of life and death, and what not that the actuaries play with, the chance that the target hit was made by Captain Jones was 10 in 13. If there is a widespread demand for "how and why" we'll publish the detailed results. Re the Yale-Princeton fracas, the chances that Princeton won, after weighing all the pros and cons was 31 in 44. And here are a couple more by Mr. Bevan, who is practically supporting this column right now.

The Pension Problem:

A retiring employee receives an annual pension proportional to the square root of the number of years of his service. Had he served 11 years more his pension would have been $300 greater but if he had retired 9 years earlier his penson would have been $300 less. How much was his pension and how long did he serve?

Aeronautics:

The bouyancy of a gas in a balloon varies as the volume and the weight of the envelope varies as the surface. A balloon whose length is 100 feet will lift a load of 500 pounds, and a similar one 150 feet long will lift 2250 pounds. What is the lifting power of a balloon 120 feet long of similar shape?

CONTENTS FOR OCTOBER, 1940

Published monthly by PUBLIC WORKS JOURNAL CORPORATION

Editorial and advertising offices: 310 East 45th St., New York, N. Y. J. T. MORRIS, *President;* W. A. HARDENBERGH, *Vice-Pres.;* CROXTON MORRIS, *Treasurer. Advertising Manager,* ARTHUR K. AKERS, 310 East 45th St., N. Y. *Advertising representatives,* FRED R. JONES, 228 No. La Salle St., Chicago, Ill.; ALONZO HAWLEY, 326 Bulkley Bldg., Cleveland, Ohio.

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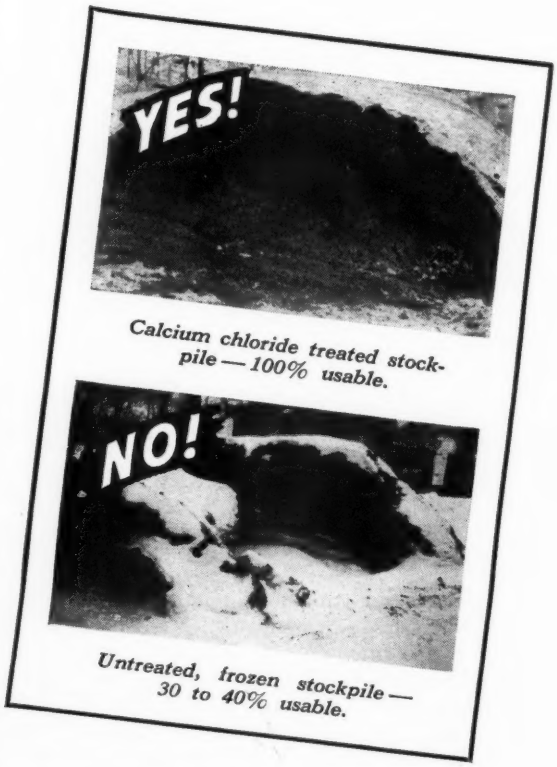

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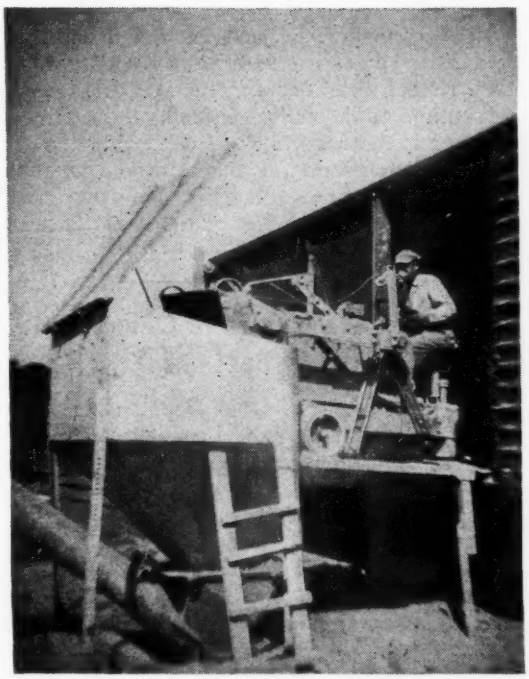
VOL. 71. No. 10



The operator of the bulk cement loader dumps his "bite" into the reservoir bin. He wears a respirator to protect him from the cement dust.

The man driving the cement loader has just released his scoop, dropping 300 lb. of cement onto the worm conveyor.

Saving Dollars in Portland Cement Concrete Highway Construction

By WILLIAM C. ANDERSON

THE theme of this treatment is economy. It can easily be taken as axiomatic that anyone concerned with the production end of construction work usually has "both ears to the ground" to keep up with any new angles on the business of saving money on the small details.

The angles presented here were discovered on an ordinary concrete paving job, involving approximately six miles of 22-foot roadway slab, 9"7"7"7"9" on curves and 5 inches thick on top of tangents of out-of-date existing pavement. The old pavement was only 18 feet wide so that the new pavement overlapped it by two feet on either side and was separated from it by a coat of squeegee to prevent bonding. The new concrete was ten inches deep in the overlapping edges.

In other respects the paving was identical with other jobs constructed under the direction of the North Carolina State Highway and Public Works Commission. The stone was graded from 2½ inches to ¼ inch; sand moisture was determined by the "saturation" method described in a previous article in this magazine and the cement was handled in bulk.

Under these very ordinary circumstances, the factors that made the difference in net profit were a few simple economy measures. The pavement began just inside the city limits of Charlotte, N. C., and ended at a point about six miles north.

Water for mixing and curing concrete was hauled in truck tanks such as those used for transporting gasoline, mounted on one-and-one-half ton trucks. At the beginning of operations when the hauling distance was in excess of five miles, three of these units, one 800 gallon, one 1,200 gallon, and one 1,000 gallon tank, were used. When the haul had been reduced to two miles the 800 gallon unit was no longer needed.

A small centrifugal pump was used to fill the tanks

Two of the tank truck units discharging a load of water. The wheels of the pump can be seen at the right.

from the water in Sugaw Creek which crosses the centerline of the project about half a mile from the zero station. At the other end of the line a pressure pump drew the water directly from the tanks to service the mixer and the curing hoses. Congestion of vehicles and machinery close in front of the paver was avoided by using 1,500 feet of pipe in the connection between pump and paver. This short length of pipe could be dragged forward outside of the forms, thereby eliminating the necessity of taking it apart and joining it after and before each day's run.

Time elapsed for emptying one tank was about 40 minutes, which indicates that the trucks had to haul something in excess of 16,500 gallons in an eleven-hour working day. About 600 gallons of this was used for curing and the remainder for mixing. It was found easy enough to make the water service continuous because while one unit could supply enough water to run 40 minutes, it took only 15 minutes to refill the tank trucks and never more than 25 minutes to go and come.

To haul this amount of water, only one of the tank trucks was required to make more than five trips per day until the elimination of the small unit made it necessary for the two remaining trucks to make from seven to nine trips a day on the shorter haul.

It is immediately obvious that a great saving is effected in the cost of pipe by following this method of securing water. The cost of pipe is in the neighborhood of $1,500 a mile or $7,500 for five miles, which amount would buy the three tank truck units outright and go far toward their upkeep. Whether overloading a one-and-one-half ton truck with a 5-ton tank of water would eventually make cost of upkeep prohibitive is a debatable point. That situation did not occur in the case under consideration and the trucks were not new when they were converted to this specialized use.

Two other savers of time and money which were used to good advantage on this job were the cement loader and the weighing batcher which together account for the labor of half a dozen men.

The bulk cement loader is a small bulldozer with a hydraulic scoop. It has a short wheelbase which makes it easily maneuverable inside the ordinary freight car. It will pick up about three hundred pounds of cement (approximately half of a six-bag batch) in one "bite" so that it keeps far enough ahead of the demand to remain idle one-third of the time. If kept in good condition its use of gasoline and oil is very economical. In all the days that the Brown Paving Company, the contractor on the Charlotte project, poured 600 six-bag batches, 900 barrels of cement, it used only ten gallons of gas a day and the prescribed amount of oil is only two quarts a week.

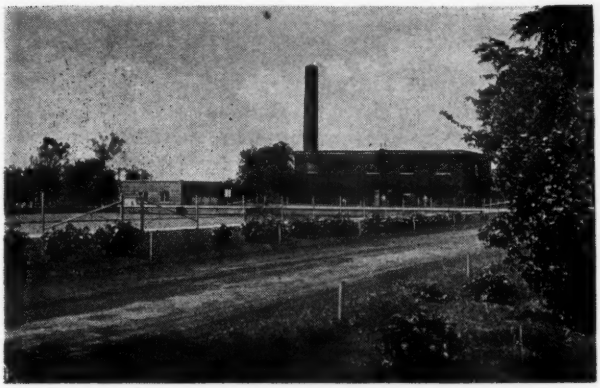
The weighing batcher consists of a reservoir bin from which a worm conveyor takes the cement to a weighing hopper. This hopper has a valve at the bottom and the cement batch is dropped through a six-inch rubber hose into the truck bodies. One particular advantage to be gained in using bulk cement in this manner is the feasibility of designing the concrete in 6.6-bag batches or any other uneven amount as well as in even bag amount. This made possible a design which fit the peculiarities of the situation well enough to eliminate waste.

Concrete Test Road in Ohio Has 49 Test Sections

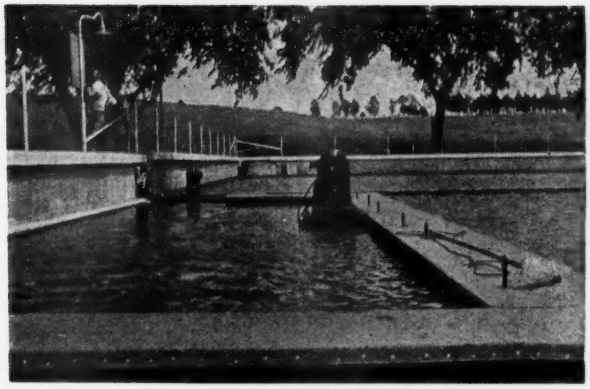
Early in July, the Ohio Department of Highways started the construction of a concrete test road on U. S. 40 west of Columbus. A principal feature in the 49 test sections will be the use of cements and combinations of different cements manufactured with and without grinding aids. Other features will be sections with an admixture added to the concrete at the time of the mixing and sections with the surface hardened with a mixture of iron, sand and portland cement. In order that a direct comparison can be made between these sections and the regular type of concrete pavements, control sections made with the usual materials are included.

Three brands of natural cement will be used, in several combinations with and without grinding aids. These grinding aids are beef tallow, vinsol resin, and petroleum distillate. The amounts to be used are very small, being less than 1/20 of one per cent of the total weight of the cement. One brand of portland cement will be used, which will be manufactured without the grinding aid, with beef tallow, and with vinsol resin. The percentage of grinding aid will be even smaller than in the natural cement. A portland-puzzolan cement manufactured from a blend of portland cement clinker and puzzolan will also be used. The puzzolan used in this cement is similar to that used by the Romans twenty centuries ago. A waterproofed cement consisting of a standard portland cement interground with a calcium stearate powder completes the varieties of cements used on the project.

The effect of the type of finishing will also be studied, as one-half of the project will be "struck-off" and finished with the regular type of finishing machine while the other half will be "struck-off," compacted and finished with a special vibratory machine. This machine is equipped with an 18 in. front screed on which are mounted 4 electric motors and vibratory units operating at a frequency of 3600 pulsations per min. Previous tests made by the Ohio Department of Highways indicate that concrete pavements finished with this type of machine should show a substantial increase in strength over the usual methods of finishing the pavements.—From a report by R. R. Litehiser and C. W. Allen, Bureau of Tests, Ohio Department of Highways, in Highway Research Abstracts.



Pumping station and settling basins



Creston flocculator built in 1939

Improvements Triple Fire Fighting Flow and Improve Domestic Supply Service

THE most extensive improvement program in the history of the Creston, Iowa, waterworks was completed during 1939. It included the construction of a 500,000 gallon elevated tank, covering and lining the clear well, construction of a flocculator and laying 11,000 feet of cast iron water main. The mains were laid as a W.P.A. project while the other items were constructed under P.W.A.

Arthur K. Olsen, Superintendent, writes us as follows: "If you will look back in your records you will see, or perhaps you may recollect, that Creston in 1934 was known far and wide for the failure of its water supply. From June 1934 to Dec. 1934, it was necessary to ship water by tank car into this town of 9,000 people, and consequently we made the headlines. The report which I have sent you summarizes what has been done to correct this situation since that time. The failure of the privately owned supply led to the purchase of the system by the City and since Feb. 11, 1934 there has been provided an adequate water supply for this city. It is very fortunate these steps were taken because on at least two occasions since 1934, we would have had the same shortage had not additional storage capacity been provided.

"Neighboring farmers are buying water from us, and they have been doing this without interruption since the fall of 1937. Such water is sold at regular rates plus a small service charge to cover the cost of filling their tanks. This source of supply has been a life saver to many farmers who otherwise would have been in desperate circumstances. This situation is likely to continue until we have an old fashioned wet year, as the moisture during the last several years has not been sufficient to replenish the ground water supply on which the wells are dependent."

More Water for Fire Fighting

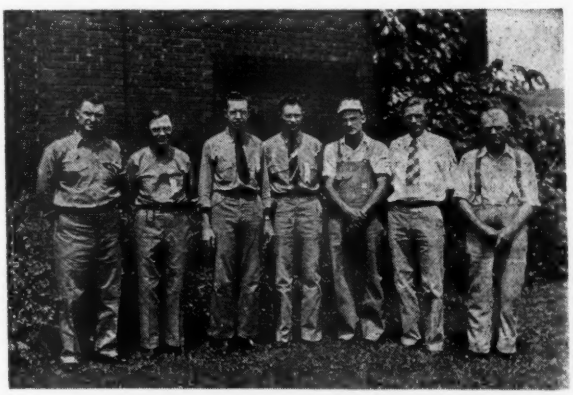
The elevated tank has more than tripled the available water for fire fighting purposes in the business section and increased the flow available in residential sections from 25% to 200%. This is due to the fact that the tank has in reality created another source of supply at the other end of the supply main. During periods of heavy draft, as would be the case with a large fire in the business district, water would be supplied to the fire equipment, both from the pumping plant and the tank.

For example: along Adams St. the maximum flow available, before the tank was constructed, was 770 gallons per minute with the pumping engine at full speed. Now with the new tank it is possible to obtain 3000 gallons per minute in this area — almost four times the old rate.

Following is a summary showing the fire flow now available in various sections of the city compared to the flow available in these same areas, prior to the construction of the tank.

Area	*Flow prior to construction of tank*	*Flow now available*
Maple & Montgomery	875 gpm.	2150 gpm.
Division & Adams	770 gpm.	3000 gpm.
Montgomery & Elm	520 gpm.	1750 gpm.
Summit & Walnut	530 gpm.	1300 gpm.
Sycamore & Prairie	385 gpm.	450 gpm.
Walnut & Monroe	400 gpm.	425 gpm.

These large increases in water available for fire



Some of the employees. Left to right: Ray Jandrey, chief operator; Milo Whittelsey, plant operator; Duane McDonald, draftsman; Virtus Beaumont, service man; Junior Crigger, plant operator; A. K. Olsen, superintendent; J. W. Anderson, plant operator.

protection, while probably the most obvious, are nevertheless but a part of all the advantages and insurance to the city accruing from the tank. Another is the added security arising from the fact that a 24-hour supply is now stored uptown, ready for any emergency which may occur. Still another is the more efficient operation of the plant by pumping at the rate for which the pump is designed, until the tank is full and then shutting down until the tank level falls a sufficient amount to allow a run of several hours again.

Main Improvements

The program of replacing all galvanized iron pipe in the system with cast iron pipe was continued during the year. A total of 11,601.3 feet of cast iron main was laid, of which 7,050.1 feet were 2-inch; 4,125.8 feet, 4-inch; 331.2 feet, 10-inch; and 94.2 feet 14-inch. As a result, there were 8,057.8 feet of galvanized pipe eliminated from the system.

The installation of the new cast iron lines results in much better service to the consumer, because the old galvanized lines are heavy with corrosion on the interior which reduces the amount of water they will deliver, and consequently the pressure to the houses they serve. The new 2″ cast iron pipe being placed will deliver three and one-quarter times the amount of water that a new 1¼″ pipe will deliver, which is the size of almost all of the galvanized pipe being replaced. When the fact that the old pipe has a heavy deposit on the interior is taken into consideration, the amount delivered by the new 2″ will be considerably in excess of three and one quarter times. In locations where 4″ cast iron replaces 1¼″ galvanized, the carrying capacity of the new line will be eighteen times that of the old.

J. C. DeLay is Chairman of the Board of Water Works Trustees of Creston, and C. A. Nord and W. S. Strunce are members. Mr. Olsen is Secretary and General Manager, as well as Superintendent.

Preparing a Water Plant for Emergencies

The Gainesville, Ga., water treatment plant was not directly in the path of the tornado that struck that city last winter, but power failure and pipe breaks caused some trouble. John E. Robertson, superintendent of filtration, suggests the following preparations against emergencies:

1. Provide a stand-by power for chemical machines.

2. Have a uniform system of locating pipes and valves, providing duplicate copies of these records to be filed in a different building. In this way, if your City Hall is destroyed and your water works men injured, a man from some other water department will be able to locate and operate the valves on your distribution system.

3. Have some quick and positive means of identification for all responsible employees of your city. If your town is under Martial Law, the water works man and other city workers will not have any trouble in gaining access to the city buildings and property if they can be promptly identified.

4. To all Public Health Officials: Visit all water works under your jurisdiction; know the men that operate them; and find out what they and their plants can do at normal times and in an emergency.

5. To all Water Works Men: Introduce yourselves to your Sanitary Engineer, County Doctor or whatever title your public health official carries. He can help you and you can help him and you will both have a big start if already acquainted when some common calamity confronts you both.

Earthquakes and Deep Wells

If this country is to continue having earthquakes, even of the milder variety, we are going to have to pay a great deal more attention to the casings on our wells. As a result of the last quake several months ago, Olympia reported that the casings on several of its wells were sheared completely. Such underground earth movements may not always produce such dramatic results as shearing a casing but they might strain it sufficiently to cause cracking, which would not be so noticeable but would still allow the entrance of contamination. It might be a good practice for our water superintendents who operate deep wells to make as complete an investigation as possible of their wells after each slight earth shock and, if necessary, pull the casing to assure themselves that no damage has been done.—*Washington State Department of Health.*

The Ideal Raid Shelter

Preparedness in ideas is as important as in physical structures. Hence the conclusions from English experiences quoted below might well be filed for reference by American engineers.

"My ideal air raid shelter," said Rotarian C. P. Munn, a builder, addressing the Hampstead Rotary Club on "My Job in War-Time," "is one built of reinforced concrete as an attachment to the house itself."

The Anderson shelter was a very good little shelter but, erected as it was in the London area on clay soil, it was liable in bad weather to become waterlogged. Hampstead Borough Council had tried to get over the difficulty by concreting the base and putting in a sump, but even that necessitated constant baling out.

Another type of shelter was the "Behive" solid block shelter, with a dome-shaped roof and circular walls, so constructed that the only effect of blast was to drive the blocks more firmly together.

A third type was the one constructed of sand, timber, and concrete. This was the type originally erected by the Borough Council in Finchley Road, and it was a very good defence against blast.

Then there was the brick shelter, which was splinterproof and very useful for people caught in the streets, but which was scarcely blast proof. Better than the brick shelter was the one made of hollow blocks filled with sand. Yet another type of shelter, such as was to be found in Regent's Park, was the solid concrete shelter placed entirely underground, but here the trouble was water seepage.

His ideal shelter was built in reinforced concrete, adjoining the house. It had a concrete base varying from 16 inches to three feet with concrete walls surmounted by an interlocking shutter carried by steel joists over which was placed a layer of concrete with clay and then a wooden roof, tiled.

This sort of shelter could be built to accommodate from four to 14 persons, and could be fitted with electric light and comfortably furnished with a divan, wireless, etc. Moreover, it would not be useless after the war, for it would serve as a larder, a store room, or a dark room. The smallest cost about £ 90 and the largest about £ 300. *Highways and Bridges* (England) Sept. 11.

The issue of "Highways and Bridges" from which the above was quoted stated that all English cement plants are working 24 hrs. a day 6 or 7 days a week, all their output being taken by the government for defense work, but that soon some would be available for private shelters.

A view of the Alto plant under construction, showing Imhoff tank and trickling filter, with channel for reversing flow in Imhoff

Small Georgia Sewage Treatment Plant Treats 200,000 G. P. D.

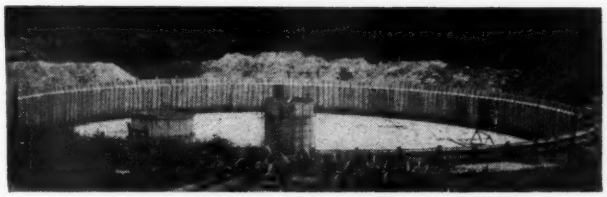
AN interesting small sewage treatment plant has been constructed to serve the Georgia Tuberculosis Sanitarium at Alto, Ga. This plant, which was designed by Robert & Co., Consulting Engineers, Atlanta, Ga., consists of a bar screen, an Imhoff tank, a trickling filter, a final settling tank and sludge drying bed. The plant is designed to treat a flow of 200,000 gallons per day from 1000 patients, which is considerably in excess of the present flow.

The screen, which is hand cleaned, provides 9 sq. ft. of screen area. Screenings are disposed of by burial.

The single Imhoff tank is 23 ft. 0 ins. wide, 33 ft. 0 ins. long, and 22 ft. 9 ins. deep to the bottoms of the hoppers, which are 4 ft. 6 ins. deep. The two sedimentation compartments are each 8 ft. 0 ins. wide, and have a total capacity of 25,000 gallons, representing a retention period at normal designed flow of 2½ hours. Sludge digestion capacity, below a plane 2 ft. 0 ins. below the slots, is about 4,000 cubic feet. Sludge removal is by gravity through a riser pipe under a head of about 6 ft. 6 ins.

A feature of the plant is the provision for reversing the flow through the Imhoff tank. This is accomplished by means of an extra channel around one-half the perimeter of the tank. The screen is located at the middle of one side of the tank and the feed channel is so arranged that the tank influent can be directed to either end of the tank. Discharge from the Imhoff tank is overflow weirs at both ends. These weirs can be adjusted for elevation or closed, thus permitting full control of the direction of flow.

There is one circular trickling filter, 80 feet in diameter, providing a filter area of 5,026 sq. feet, and equipped with an American Well Works rotary distributor. The filter is 6 feet deep, and is designed for an application rate of 300,000 gallons per acre-foot per day. Split tile underdrain, 18 inches on centers are used; filter media is 1-inch to 3-inch stone. The distributor is mounted on a center pier, and the central drainage channel is split around this pier. This channel is covered with concrete slabs. A 6-inch siphon in a 350-gallon dosing chamber feeds the distributor. Filter walls are of concrete, with a freeboard of 6 inches.



Trickling filter under construction

The final settling tank is of the rectangular type, 33 ft. 0 ins. long, 11 ft. 0 ins. wide and 6 ft. 0 ins. water depth, equipped with Link-Belt Straightline Collectors. There are three overflow weirs—one at the outlet end and two feeding into a suspended trough 5 ft. from the outlet end. Sludge from the final settling tanks is returned to the Imhoff tank by a Domestic sludge pump through a 4-inch line, which discharges into the sludge compartment of the Imhoff tank or the raw sewage.

The capacity of the final settling tank is 16,335 gallons, providing a detention period at normal design flow of about one and one-half hours.

There is one sludge-drying bed, which is not covered (very few in Georgia are covered due to climate). Dimensions of the sludge-drying bed are 40 feet by 25 ft., with an area of 1,000 sq. ft., or 1 sq. ft. per person. It consists of an underdrain system over which are placed 3 ins. of ¾ to 1⅛-inch gravel, 3 ins. of ¼ to ¾-inch gravel, 3 ins. of ⅛ to ¼-inch gravel, and 9 inches of sand. Drainage from the sludge bed is through the plant effluent line to the creek.

A finished stretch of road.

Details of Soil Stabilization

By JAMES M. LOTH
County Engineer, Crawford County, Kansas

A SOIL stabilization project was sponsored by Crawford County, Kansas, utilizing WPA labor, a concrete mixer and emulsified asphalt, on about two miles of quite heavily traveled road. This road was well-graded, with a 26-ft. roadway, and had a surface of flint chats, which type of material is available at low cost in Crawford County. Considerations involved in selecting the type of surfacing included both initial and maintenance cost and the employment of as much labor as could be justified, while having an efficient and well balanced project. With these considerations in mind, it was determined to construct a soil stabilized base with a pre-mix asphalt wearing surface.

Investigations and Preparations

Having had no previous experience in the construction of soil stabilization, we spent a great deal of time studying quality and cost of this type of construction, also the simplified operations to get the desired results.

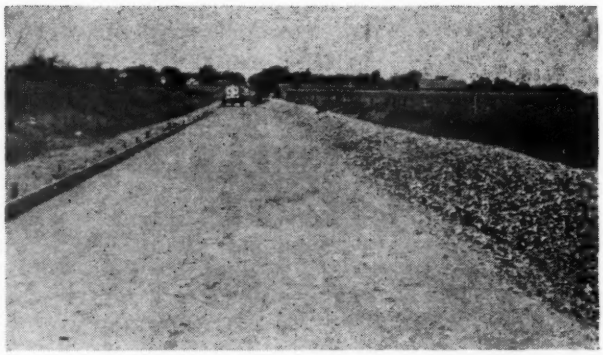
Samples were taken from locations along the two-mile stretch of road where surfacing and soil seemed to differ. These samples were forwarded to a testing laboratory for absorption and stability, and this data, along with our treated samples, was returned. These samples, when tested, required 7.88% bitumen content, hereafter called stabilizer, and required more stabilizer than we figured we could afford. This 7.88% stabilizer was due to 52.5% of soil tested passing No. 200 mesh screen washed; therefore, we figured that by blending our soil base with 40% crushed stone it would reduce the stabilizer content to approximately 4.25% and still produce a stable base.

Having planned the base to our satisfaction, it was then necessary to plan the pre-mix asphalt wearing surface. We first decided on a dense graded mix as this type of asphalt surface required no immediate seal coat. Mineral aggregate for this mixture should be sound crushed ledge rock or crushed gravel, stone chips, sand and crusher dust combined to meet a grading as follows:

Percent Passing Screen

Round ½"	100
Round ¼"	85 to 100
Square No. 10	45 to 60
Square No. 40	15 to 35
Square No. 80	10 to 20
Square No. 200	4 to 10

After considering the cost of producing this material from our rock crushing plant located eleven miles from the project, we investigated the chat fields located south of our county, and ran the gradations which, much to our surprise, gave a gradation within the required gradings listed above. This aggregate can be purchased and delivered for approximately one third of the cost that we could produce the same gradation from our own plant.



Equalized windrow, with mixer in the background.

The formula used to calculate the percent of bitumen binder based upon the washed gradings of the aggregates was: P = .05 A plus .1 B plus .5 C in which:

P = total percent by weight of bitumen based upon the weight of the graded aggregate.

A = percent of the aggregate retained on No. 10 sieve.

B = percent of aggregate passing No. 10 sieve and retained on No. 200 sieve.

C = percent of the aggregate passing No. 200 sieve.

Selection of Equipment

Equipment necessary for construction, to conform with our specified method of construction, included the use of our No. 50 Adams motor grader with scarifier attachment; a 5- to 10-ton self-propelled roller; a trailer type mixer with water and emulsion tanks and acrometer attachments; portable water and emulsion tanks; portable emulsion pump (used at tank car); two-section sheepfoot roller; 30 H.P. Caterpillar tractor; rubber tired wheelbarrows; concrete

With Emulsified Asphalt

James M. Loth

Soil materials carefully selected and graded, combined with emulsion in a portable mixer, rolled with a sheepfoot followed by a 10-ton roller, and covered with 1½ inches of pre-mix asphalt.

carts; and a water sprinkler tank placed on flat bed truck.

Small tools consisted of picks and shovels, 2″ x 8″ pine forms staked in place with 2″ x 4″ stakes, a template for the fine grading operation, and steel gauge pins for use in the laying of the base.

General Outline of Operations

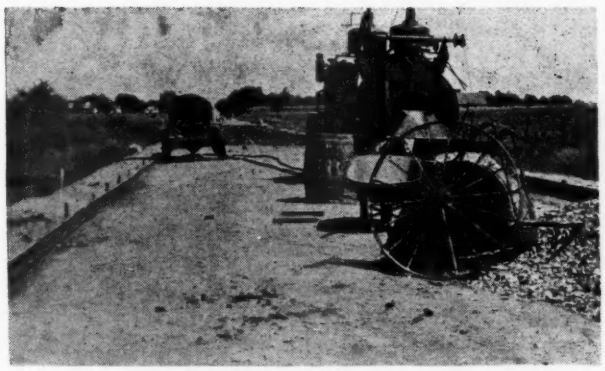
Upon the existing road bed, stakes were set by the engineer, giving lines and grades at 50′ intervals and all necessary plus stations. Then followed the motor grader with scarifier attachment which scarified the present road bed the full width of the proposed pavement with plus six inches on each side for the setting of forms; the motor grader worked to within approximately one half inch of the proposed bottom of the base.

Forms were then placed, and along one edge of the proposed pavement edge, for approximately 5′ wide, the base was fine graded and rolled with a 10 ton roller to carry the equalized windrow for the stabilized base.

The balance of the road bed was then graded down to within one half inch of the finished grade, placing all the top portion of the present road bed materials and soil in the place prepared to carry the windrow. The windrow was gauged to approximately the proper amount, and the excess excavation, if any, was used in the shouldering and sloping of the road bed.

Where additional excavation or earth was needed to provide material for the equalized windrow, shouldering or insloping, both the present ditches were widened or the ditch back slope laid back; this all being cared for in the planning of the proposed grade. This moving of excess materials, widening of ditches and laying back of the back slope was called grading in cubic yards—the scarifying and windrowing was in square yards. Fine grading was in square yards and included forms and form setters, a 10-ton roller and hand labor.

Concrete mixer and portable water tank.



Concrete mixer. Windrow at right foreground.

The finished subgrade was checked with a template and was identical with the grade and cross-section proposed; this is essential for the accuracy of the subsequent operations.

The equalized windrow was then checked as to conformity and quantity, using an adjustable windrow box pulled by a motor grader, the windrow containing the existing road bed materials. We then took samples at various intervals to determine the quantity of crushed limestone rock less all grading passing the ¼″ mesh screen; then the blend rock was added to the windrow by hand labor and truck. Then followed the laying of the stabilized base. The subgrade, when necessary, was sprinkled to lay the dust, the trailer-type mixer, water and emulsion tanks, wheelbarrows and concrete carts, and the necessary small tools were set at the beginning of the windrow for operation.

The windrow was marked off with steel header plates in batch quantities and the emulsion and water added to the batch as calculated by the construction engineer. The batch was then discharged into the concrete carts

(Please turn to page 38)

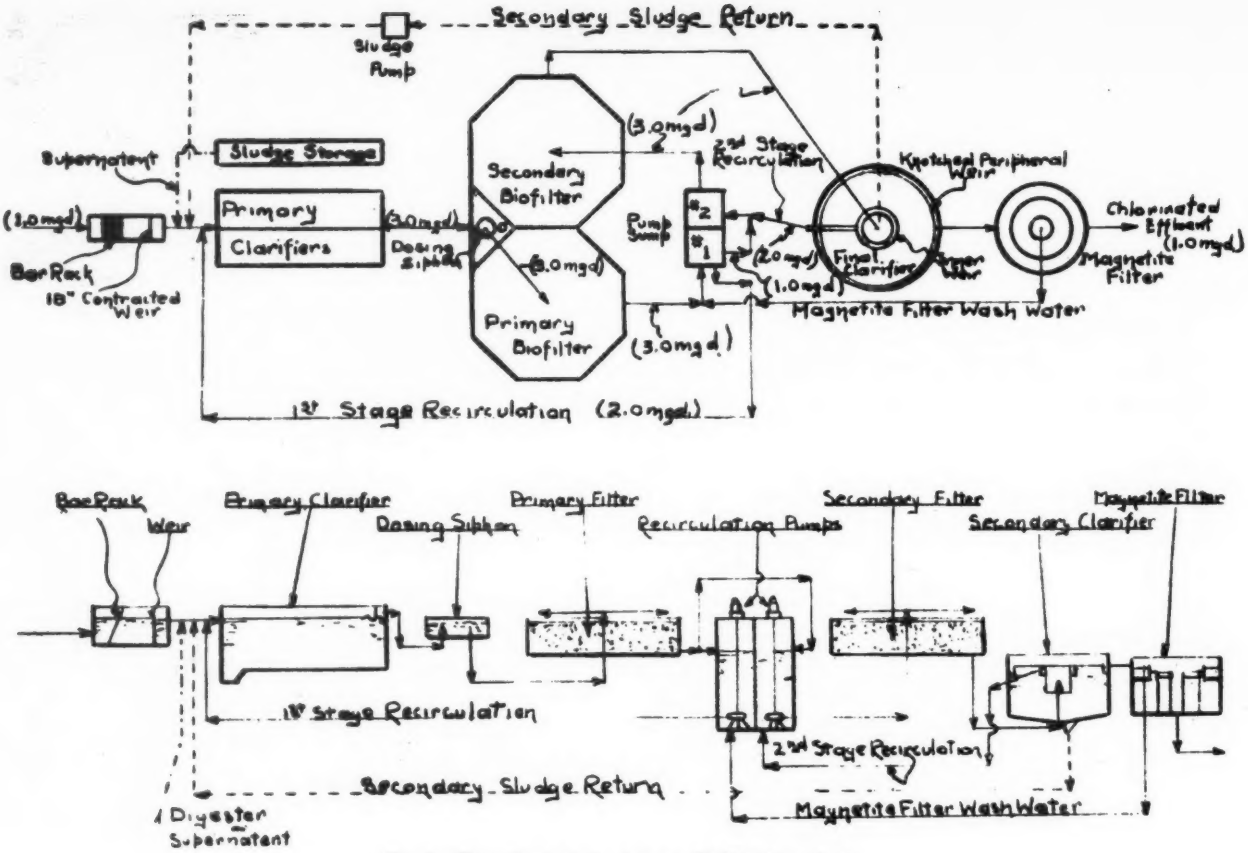


Fig. 1—Flow sheet of the Liberty Biofiltration plant.

A Month's Operating Results at the

DURING the period of August 28th to August 30th inclusive, and September 2nd to 5th inclusive, tests were run to obtain operating results at the Liberty, N. Y., newly installed Biofiltration plant, described in the July issue of PUBLIC WORKS.

Data were obtained on flow readings, temperatures of sewage and air, B.O.D.'s, suspended solids, total solids, D.O.'s, ammonia, nitrite and nitrate nitrogen.

The raw sewage flow was determined by the use of an 18-inch contracted weir located in the influent channel just after the screen (see sketch No. 1). These flows were gauged every hour, twenty-four hours a day. The raw sewage consisted of domestic sewage, storm water, laundry wastes, milk wastes, and slaughter house waste.

The samples collected for these tests were 24-hour composites taken every hour from 8 a.m. to 7 a.m. the following day. The raw sewage sample was collected as an aliquot proportion of the incoming flow, and did not contain recirculated filter effluent, secondary clarifier returned sludge, nor digester supernatant. The effluent samples from each successive unit were 250 c.c. samples composited.

The temperatures of the air and sewage were recorded at 9:30 a.m. each day.

The five-day B.O.D.'s and the suspended solids were run on the 24-hour composite for each sample collected, and the total solids were run on the 24-hour composite of the raw sewage and the final clarifier effluent only.

The turbidities were run on the 24-hour composite and grab sample taken during the peak of flow for the final clarifier and magnetite filter effluents only. The D.O.'s were run on grab samples from the primary clarifier and secondary clarifier effluents morning and afternoon.

Description of the Plant

This plant was designed with maximum flexibility to meet fluctuations in flow and in contributing population due to the seasonal changes in both. Liberty is a summer resort, having a summer population of 11,000 to 13,000 with load population of 20,000 and a winter population of only 5,000. During the summer the load on the plant is high, due to the operation of laundries, milk receiving stations, and a slaughter house. During the wintertime these industries do not contribute materially to the load on the plant.

Due to the design of the plant, it is possible to obtain different degrees of treatment to meet the varying conditions. It is contemplated to run the plan during the summer months as a two-stage Biofilter, while during the remainder of the year recirculation will be discontinued and the plant run as a standard filter.

The flow sheet used during the test period, shown in Figure 1, gives the design flows through the following units in succession: The raw sewage enters a mechan-

General plan of Liberty sewage treatment plant.

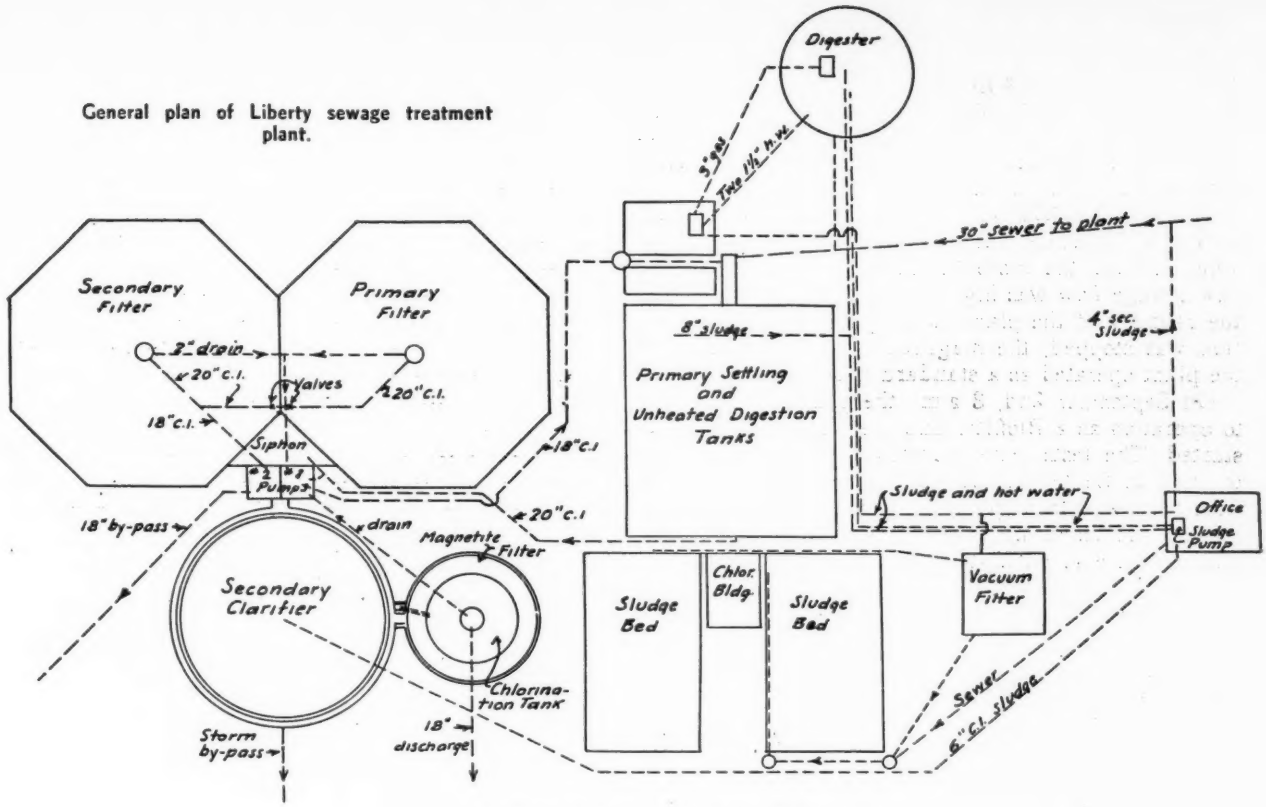


Fig. 2—General plan of the Liberty plant.

Liberty Biofiltration Plant

ically cleaned bar screen, after which it is combined with the recirculated flow from the primary filter, digester supernatant and secondary clarifier sludge, and distributed between two primary rectangular clarifiers. The recirculation is continuous, whereas the supernatant from the digester and the secondary clarifier sludge is returned intermittently during such times as is necessary. The effluent from the primary clarifiers enters a dosing siphon which feeds the primary Biofilter continuously, the effluent from which enters pump sump No. 1, where a proportional amount is recirculated ahead of the primary clarifier; the balance enters pump sump No. 2, and is combined with a proportional amount of final clarifier effluent and is pumped to the secondary Biofilter. The underflow from the secondary Biofilter is siphon-fed to the final clarifier. The clear supernatant is decanted by a notched weir on the periphery and an innner weir around the influent well (for recirculation). The outer weir overflow is fed to a circular magnetite filter, the underflow of which enters a chlorine contact tank in the center of the magnetite filter structure. Figure 2 shows the plan of the entire plant, with the disposal of the digested sludge by either sludge sand beds or vacuum filtration.

Operating Results

A summary of the results obtained is shown by the table at the right.

Summary of Operating Results

	8-28	8-29	8-30	9-2	9-3	9-4	9-5
Flows (mgd)							
Maximum	1.29	1.25	1.17	2.09	1.58	1.38	1.38
Minimum	0.31	0.36	0.33	0.87	0.62	0.45	0.45
Average	0.67	0.73	0.72	1.34	1.04	0.92	0.85
Dosing Rate (mgad)							
Prim. Filt. Raw	5.82	6.35	6.26	11.67	9.05	8.00	7.40
Prim. Filt. Total	25.80	26.30	26.20	31.60	29.00	28.00	27.40
Sec. Filt. Raw	5.82	6.35	6.26	11.67	9.05	8.00	7.40
Sec. Filt. Total	28.10	28.10	28.10	28.10	28.10	28.10	28.10
Recirculation Ratio (recir. to raw)							
Prim. Filter	3.44	3.2	3.15	1.72	2.21	2.50	2.72
Sec. Filter	3.84	3.49	3.45	1.42	2.12	2.52	2.81
Detention (hours)							
Prim. Clarifier	1.25	1.22	1.23	1.02	1.11	1.15	1.18
Sec. Clarifier	1.85	1.65	1.66	1.34	1.48	1.54	1.57
Overflow Rates (gal./sq.ft./day)							
Prim. Clarifier	1325	1350	1345	1625	1490	1440	1405
Sec. Clarifier	945	965	960	1180	1075	1035	1005
Temperature (°F)							
Air	52	55	62	69	63	62	58
Sewage	66	66	66	66	67	66	66
B. O. D.'s (ppm)							
Raw	192	290	120	140	350	140	180
Sec. Clarifier	25	28	20	29	23	27	21
Magnetite Filter	-	-	10	21	10	8	13
% Removal							
Sec. Clar. Effluent	87.0	90.4	83.3	79.3	93.2	80.7	88.4
Mag. Filt. Effluent	-	-	91.6	85.0	97.0	94.3	93.8
B. O. D. Loading (#/cu.yd./day)							
Raw Sewage	0.96	1.58	0.63	1.40	2.71	0.96	1.14
Suspended Solids (ppm)							
Raw	177	212	216	104	123	161	128
Sec. Clarifier	23	39	32	23	19	23	20
Mag. Filter	-	-	15	12	8	8	6
% Removal							
Sec. Clar. Effluent	87.0	81.6	85.2	78.0	84.5	85.7	84.4
Mag. Filt. Effluent	-	-	93.0	88.5	93.5	95.0	95.3
Turbidities (ppm)							
Final Clarifier (Grab Sample)	-	-	10.5	10.0	12.5	9.7	9.0
Mag. Filter (Grab Sample)	-	-	5.0	5.0	5.5	5.1	5.0
Final Clar. (24-hr. comp. sample)	-	-	12.0	11.0	5.0	6.5	6.0
Mag. Filter (24-hr. comp. sample)	-	-	5.0	6.5	4.2	4.3	3.6
D.O.'s (ppm)							
Prim. Clarifier	0.0	0.0	0.0	1.1	2.6	2.1	1.1
Final Clarifier	7.6	8.3	5.4	4.9	5.5	5.0	5.1

Discussion of Operating Results

The above data show a loading less than was expected, mainly due to the fact that 24-hour composites were used, which gave an average over the twenty-four hours, whereas a grab sample at the peak of loading might be two to three times that of the average. Another reason for the weakness of the sewage was attributed to dilution by rain water causing excessive amounts of flow in the sewers.

August 28th, 29th and 30th were rainy. On August 31st and September 1st there was a severe rain storm which caused the discontinuation of these tests. The raw sewage flow was highly diluted and far exceeded the capacity of the plant. During this time, recirculation was stopped, the magnetite filter by-passed and the plant operated as a standard trickling filter.

On September 2nd, 8 a.m., the plant was returned to operation as a Biofilter and the magnetite filter restarted. The tests were resumed and were continued through to September 6th, 8 a.m. During the period September 2nd through September 5th, the rain water dilution persisted but was gradually abating. This dilution gave low results on the strength of the raw sewage, as can be seen in the operating results above.

The existing sludge storage tanks were being used for the temporary storage of the raw sludge. The capacity of these two tanks was not sufficient to obtain clear supernatant for return to the primary settling tanks; the overflow is returned automatically by a pump controlled by a high and low water float, causing the return of approximately 15,000 gallons of supernatant at one time. This imposes a very heavy load that is difficult to treat. A new digester (since completed) will give sufficient capacity to obtain a normally clear supernatant. This new digester will act as a primary of a multistage digestion system, using the existing storage tanks as the secondaries.

The returned secondary clarifier sludge was also pumped back to the primary clarifiers intermittently for approximately 15 minutes to one half hour twice a day.

Since the test run, the operator, Harry Eichenauer, has continued to run tests on a 4- or 5-day schedule. These tests are composites of hourly samples taken on raw sewage from 8 a.m. to 2 p.m. and on effluents from 9 a.m. to 3 p.m. The latest results are as follows:

	Sat. Sept. 14	*Thur. Sept. 19*	*Mon. Sept. 23*	*Thur. Sept. 26*	*Sat. Sept. 28*	*Mon. Sept. 30*	*Tues. Oct. 1*	*Average Sept 2 to Oct. 1*	*Average* Sept. 14-30, 1939*
BOD, raw	380	320	280	210	430	...	...	275	480
BOD, sec. clarifier	16	9	10	11	10	...	...	17	...
BOD, final effluent	14	4	1	3	4	...	...	8.7	113
Suspended solids, raw	196	160	232	164	220	224	240	176	...
Suspended solids, secondary clar.	16	7	...	9	4	5	8	13.4	...
Suspended solids, final effluent	...	1	2	2	2	1	2.4	4.4	...
Dissolved oxygen	6.3	6.4	6.4	7.4	7.5	6.8	6.8	6.2	...

*These BOD results of a year ago, when using chemical treatment, are given for comparison—76% reduction as compared to 96.8%.

Precautions in Handling Sludge Gas

SEVERAL major accidents due to explosion of gas at sludge digestion plants, and numerous minor ones, emphasize the importance of taking precautions in constructing and operating such plants. Some plants display signs forbidding smoking around digestion tanks and gas utilization buildings; which is a wise precaution, but "as the sources of ignition are so numerous and uncontrollable * * * the only safe procedure would be to consider a source of ignition present at all times and work toward maintaining the gases in digesters and collecting systems as pure as formed and under pressure," says the Committee on Gas Hazards of the New Jersey Sewage Works Association.

The chairman of a committee of the American Gas Association appointed to study gas explosions, had his attention called to sludge gas plants and was "much perturbed by some of the conditions" existing. Speaking before the New Jersey Sewage Works Association, he urged on the members that gas must always be kept under pressure, so that no atmospheric air can get into any vessel or pipe containing it; and absolutely isolated from any high-pressure air systems. "All gas holders and other containers should be absolutely sealed off by liquid seals that open only into the air" and which should never be shut off or permitted to fill with solid material. Floating tops should never be permitted to be grounded; and when taken out of service, inlets and outlets must be closed absolutely tight. If sludge or liquor is to be removed from a covered tank, the air space above should be purged with an inert gas before air is admitted; which gas can be CO_2 from a cylinder or an automobile exhaust, admitted slowly so as not to freeze the connection.

Among the dangers are irregular production of gas causing varying pressures in the digestion or septic tank; removing covers so that air can enter; loss of liquid from seals. No liquid seals or blow-offs should be vented to other than expansive open air.

Many gas lines are too small; they should be at least 3" or 4" in diameter, to reduce pressure loss to a minimum. There should be more gauges to show exactly what the gas pressures are at various points in the gas system.

If there is suspicion of gas leakage in any room or enclosure, an explosive gas indicator should be used, such as the "Explosimeter," the "All Gas Detector," etc. Other precautions are the use of rubber-soled shoes by employees at the plant; of non-sparking electric motors and non-sparking tools. Electric heating of rooms in buildings where gas might escape would be dangerous.

Sewer gas is explosive when mixed with air in proportions of 8% to 18% gas—about 13% is the most dangerous.

The Committee on Gas Hazards has prepared a report, giving recommended principles for the safe design of gas-handling equipment at sewage treatment plants, and instructions to superintendents and operators of sewage systems and sewage treatment plants.

The Editor's Page

Sound Engineering Needed in National Defense Plans

Right now this nation is engaged in a gigantic effort to make up for the time lost during the past twenty years of unpreparedness. For a good many years, money that should have been spent in keeping our army and our navy in a reasonable condition of readiness has been withheld or spent for other and far less necessary things. Fortunately we are not faced with the emergency of war and therefore we have some freedom to take the time to do things in a sound way.

Furthermore, our plans contemplate a sustained effort. Conscription is with us for the next five years at least—and probably for more years to come. There is really little chance that we will ever return to the basis of an army of around 200,000 men; it is almost certain that for the next decade we will maintain under arms some 700,000 or 800,000 men, even though we continue our present peaceful status.

For that reason, we should plan and we should carry out our preparedness projects for the future as well as for the present. And in that connection, what about sanitation, highways and similar facilities? Should we design and build these as though the devil were chasing us right now, and with no thought of the years to come? Not only will it be shortsighted to do so, but the chances are, as everyone with experience in engineering, operation or maintenance knows, that it will cost us far more in the end.

In highways, even the best of surfaces will not carry traffic loads unless they are placed on a properly prepared and stable subgrade. This means subdrainage and the use of blanket courses. In addition, since this is definitely and irrevocably a high-speed age, highways should be planned for safe use and for maximum capacity. Wide curves, sound alinement, banking, safe intersections and crossings, and properly constructed bridges are necessary and should be provided.

In sewerage and sewage treatment, it is impossible to conceive that an uptodate engineer will repeat the mistakes and errors of 1917. Modern sewage treatment equipment and plants designed on the basis of our present knowledge of waste disposal are elementary requirements. And secondary treatment should be utilized freely to prevent the recurrence of the crimes of stream and soil pollution of twenty-three years ago. Except under unusual circumstances, no plant should be installed with primary treatment only. Advantage should be taken of the late developments for obtaining better sewage treatment at low cost, and without giving too much weight to simplicity of operation. For as we have said before, this program is going to last a long time, and it will be but simple common sense to have competent operators to insure obtaining full value from the nation's investment in these utilities; and there is not the slightest reason why competent operators cannot be obtained.

Disposal of solid wastes, as garbage and other refuse, cannot be solved satisfactorily either by refuse dumps, feeding to hogs or 1917 model incinerators. Refuse dumps will become mighty tiresome between now and the time that our present program ends—if it does end. Incinerators copied from what was uptodate and modern in 1917, will cost far more in the end than those designed with 1940 knowledge.

In water supply, progress has been marked, though the basic factors of plant design have not changed greatly. A better knowledge of the use of chemicals in plant control, and a greater variety of tools with which to apply them effectively have come with the years. Equipment for mechanical cleaning of sedimentation basins, permitting more efficient plant operation, has won its place through performance in actual practice.

These are only a few of the things that need to be considered from the viewpoint of 1940 instead of 1917. Engineering has progressed greatly, and there is no more place in our present program for utilizing world war public works engineering than there is for basing our mechanization plans on 1917 model trucks and tractors and tanks.

And the cost of doing these things right instead of in the old ways? In the end, far less; right now probably one one-hundredth of one per cent of what we are planning to spend on defense would be an excessive estimate. Actually, with sound planning it will cost less initially.

Here is a challenge to the engineers and officers of the Army, to the consulting engineers who have to do with the planning and construction of our new camps and posts, and to the State Sanitary Engineers of the various states in which these will be located. Here's hoping that they have the backbone and the courage to stand up for what they know is right, and what they know is sound engineering.

Cities and Counties to Aid in National Airport Program

According to a recent announcement of the Civil Aeronautics Authority, some 4000 airports will be built in the near future. In cooperation with the WPA and local authorities, plans are now reaching a definite stage. The House has voted $80,000,000 in cash and contractual authority to start the program, but at this writing the bill has not reached final shape.

Under the present plan, the WPA will supply the labor and much of the material to construct the landing fields. Cities and counties will supply the land and provide the construction equipment, such as tractors, bulldozers, graders and power shovels necessary for carrying on the work.

Runway surfaces will be paved, involving a tremendous yardage of surfacing. There will be required also water supply facilities and sewage disposal equipment for each field. In the winter, snow removal will be necessary in the north to keep the runways clear for use. These are only a few of the phases of work involved, the decision for most of which will lie in local hands.

WPA men laying some of the more than 445,000 sq. yd. of sodding which was placed on this superhighway.

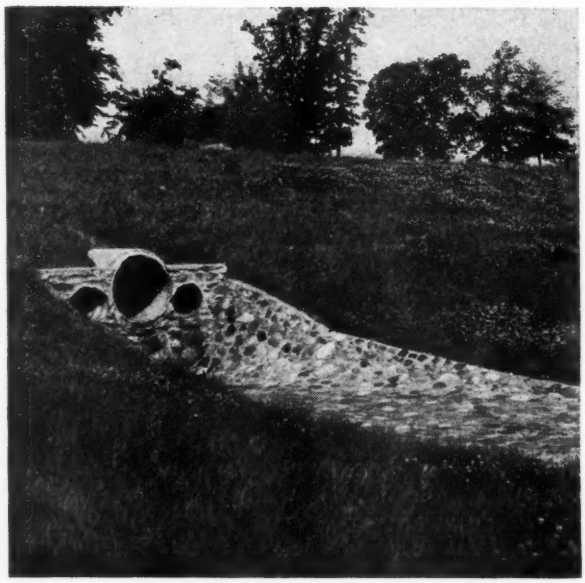
The Minneapolis

THE construction season of 1940 will see the completion of the largest highway construction project undertaken in the state of Minnesota by work relief labor. This WPA project consists of grading and landscaping 7.9 miles of trunk Highway No. 100 just west of the city of Minneapolis under the sponsorship of the Minnesota Department of Highways.

This project, known as the Minneapolis Belt Line Highway Development, parallels the western limits of Minneapolis from the junction with the U. S. Highway No. 169 to the junction with U. S. Highway No. 52 in Robbinsdale. In addition to the 7.9 miles of Trunk Highway No. 100, it was necessary to reconstruct one mile of Trunk Highway No. 7 in order to provide a full clover-leaf separation, and two miles of U. S. Highway No. 12 to provide necessary realignment and clover-leaf separation.

The Belt Line Highway intercepts the traffic from five major highways approaching the city of Minneapolis from the southwest, west, and northwest. These carry an average daily traffic volume of more than 15,000 vehicles, and the volume approaches 25,000 vehicles per day during the summer months. Prior to the construction of this highway, all this traffic had to pass through the congested business districts of Minneapolis, with resulting delay to through traffic not destined for the Twin Cities. Especially penalized by these delays were the hundreds of trucks bound daily for the South St. Paul stockyards, second largest livestock market in the world. An average of 650 trucks enter South St. Paul daily, with the bulk of these coming from the western part of the state. A large portion of this truck traffic now has been diverted around the Twin Cities by means of belt line highways.

Radius point, with reflector buttons on an island at the junction of Minneapolis Belt Line highway with a major trunk highway.



Headwall for culvert, showing 12" shoulder drain outlets and ruffle spillway. Note growth on seeded slopes.

When work relief funds became available for highway construction, the project was immediately selected as one providing an ideal outlet for the employment of a fluctuating load of relief labor, supplemented by the use of standard excavating units which were not seriously affected by the variable labor factor.

Located parallel to and approximately one mile west of the city limits of Minneapolis, the new belt line highway passes through several suburban residential areas. It was necessary, therefore, to design a highway which would not only be in the nature of a parkway in roadside treatment, but would also provide an uninterrupted flow of moderately high speed through traffic by separating major intersections, and also care for the relatively large amount of local traffic.

The through traffic was provided for by the construction of a 60-foot roadway over the entire length, with critical portions divided into two 30-foot lanes. Five highway grade separations were constructed, two of which are full clover leafs. Seven railroad grade separations also were provided and right of way has been secured for at least two additional clover-leaf

Belt Line Highway Development

Grading and landscaping eight miles as a WPA project—the largest work relief highway project in Minnesota. One cut approximated 250,000 cubic yards.

intersections which can be constructed in the future. Approximately 20 miles of service lanes and connecting legs, varying from 22 to 30 feet in width, have been constructed.

The parkway has been designed to blend in with the surrounding terrain. All slopes and ditches were seeded and sodded and native trees and shrubs were planted to beautify the right of way. So successfully was the new construction blended in with the natural topography that all but experienced highway engineers underestimated the amount of excavation actually done.

The actual construction involved many difficulties inasmuch as the highway traversed a rolling terrain which required careful balancing of cuts and fills. The largest cut consisted of approximately 250,000 cubic yards, while adjacent to this cut was a swamp having a depth of 60 feet. A large amount of storm sewer construction was necessary through the built-up residential sections and extensive sub-surface drainage had to be provided for one springfed swamp. All types of soil were available on the right of way or adjacent thereto and a selection of soil materials was made to provide a stable roadbed. Peat excavated from swamp sections was used as slope cover material and as fill between the legs of the clover-leafs. All swamp fills were of sand, and sufficient gravel was available to surface all roadways without excessive haul. All top soil was stripped and stockpiled for use as slope cover in connection with the peat. Subsurface explorations were made as a basis for the design of embankments and as an aid in the use and selection of materials.

All usable material available on the project was salvaged and utilized. Trees cleared from the right of way were cut up into firewood for the camp. All trees and shrubs which could be saved were transplanted. The stone foundation of an old grain elevator was salvaged for use in masonry work, and many of the manholes and catch basins were constructed of stone masonry. Old concrete pavement was used for riprap and for the stabilization of ditch slopes.

Because of the magnitude of the project and the variety of work involved, a complete construction camp of portable buildings was assembled. This camp included, in addition to WPA and Highway Department field offices, a complete blacksmith shop having some machine shop equipment, a carpenter shop, a paint shop, tool house, stone cutting shed for winter work, tractor sheds and miscellaneous storage sheds, as well as shelters for the men.

The grading and landscaping was done by force account, while the 14 bridges required were built by the contract method. The portion of excavation done by hand included landscaping work, the cutting of sod, finishing of slopes, construction of masonry drainage and erosion control structures, and most of the sewer construction.

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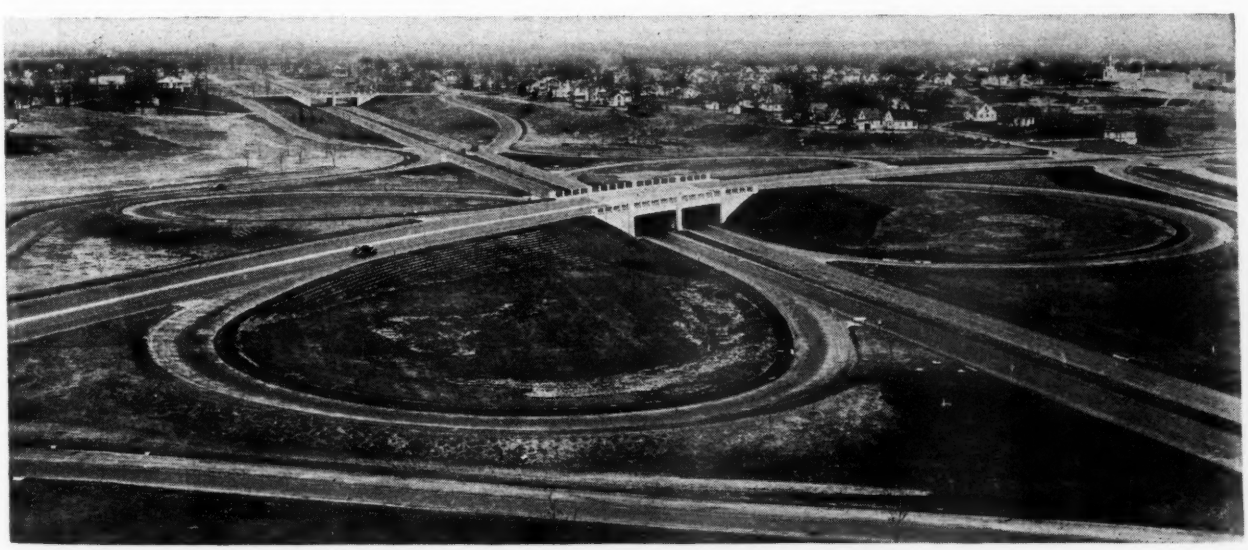


Clover leaf on belt line and highway No. 7, Minneapolis.

Courtesy Centriline Co.

Pipe lining equipment used to line Akron steel force main with cement mortar.

Lining Large Steel Water Pipe With Portland Cement Mortar

TO prevent further tuberculation approximately 20-, 000 ft. of 36-in. and 14,000 ft. of 48-in. steel force mains have been lined with portland cement mortar by the Bureau of Water Supply of the City of Akron, Ohio. The pipe forms part of the two parallel lines which deliver water to Akron from Lake Rockwell near Kent.

Cost of the lining—some $66,000—will be returned in less than 10 years through the saving in cost of pumping against the friction head created by tuberculation and the reduction in amount of ordinary repairs. It is estimated that annual pumping and repair bills will be decreased by as much as $7,000.

Pipe was first cleaned by a water-propelled machine developed by the National Water Main Cleaning Co. Workmen then removed rust, coating and organic matter not flushed out by the preliminary cleaning procedures.

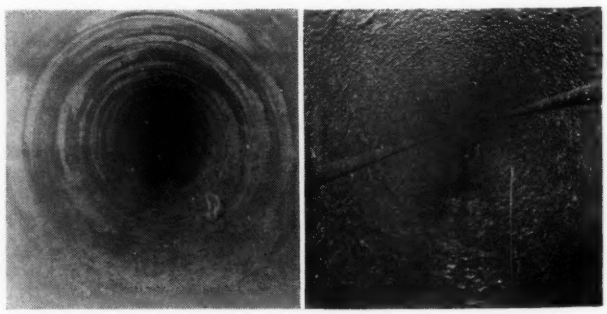
Concrete lining, ¼ to ½ in. thick, was placed by a rapidly moving head, mounted on a carriage, which threw the relatively dry mortar (1:1 mix) against the pipe. A series of paddles attached to the lining machine smoothed the lining, producing a dense, hard surface. A portable electric generating machine supplied power to the lining apparatus. The lining machine operated in the pipe on three wheels—two in front and one in the rear. The rear wheel so guided the machine that neither tracks nor special equipment for curves was required.

The electric generating set was operated from above ground, power being supplied to the lining machine through cables strung in the manholes.

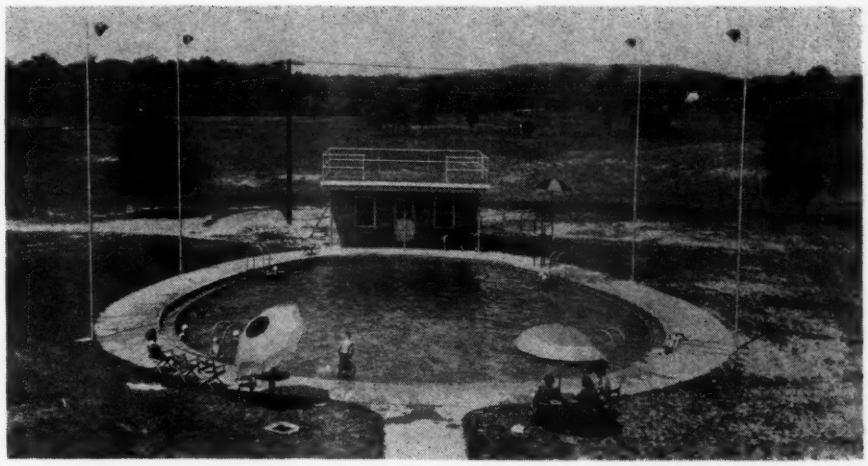
Mortar for the lining was mixed outside the pipe and conveyed to the lining machine in small cars operated by storage batteries. All sand was double screened through a 16-mesh screen and thoroughly dried. The mix was thus accurately controlled and the water-cement ratio was kept to the minimum. The mortar supply cars delivered the mixture (half of a six-bag batch) in a half cylinder hopper to a low trailer car attached to the lining machine. From this trailer it was handled manually to the lining machine hopper whence it was conveyed to the revolving head mechanically.

The thickness of the pipe lining was determined by the speed at which the lining machine moved. In a 48-in. pipe the rate was approximately 4 lin. ft. of ¼-in. lining per minute.

Excavation and hand cleaning of pipe was done by WPA labor. Cutting, welding and general repair of pipe was done by construction forces of the Bureau of Water Supply aided by WPA forces. Mechanical cleaning of the pipe, lining, and supervision were provided by contract by the Centriline Co., subcontractor for T. A. Gillespie Co., New York City. Materials were furnished by the city and the WPA. The entire project was sponsored by the Bureau of Water Supply, City of Akron, Ohio. The city's forces were supervised by W. F. Peters, Director of Public Service, and W. R. LaDue, Supt. and Engineer, Bureau of Water Supply.



Steel force main before cleaning and after placing mortar lining.



Swimming pool and filter house at Commissioned Officers' Club at Fort Knox.

Public Health Aspects of Bathing Pool Sanitation

By HAROLD B. GOTAAS
Dept. of Sanitary Engineering, School of Public Health, University of North Carolina

THE bathing pool has developed as an institution for improving public health, but may be and sometimes is a menace to it. The design and operation of the pool determine whether it is an asset or liability to public health. The bathers in a pool are all in contact with a common medium in which infective organisms may remain viable long enough and in large enough concentrations to infect bathers unless adequate precautions are taken.

The diseases which can be transmitted in pools may be divided into two general groups—those which may spread between bathers in crowded pools into which the water comes from a clean, unpolluted source, and those which might be contracted where the water is polluted with sewage. In modern artificial pools, using water of the drinking water standard, the diseases of the first group are most important.

Typhoid fever, dysentery, venereal diseases, conjunctivitis, trachoma, jaundice, Weils disease, upper respiratory tract diseases (naso pharynx and sinus infection, and septic sore throat), middle ear infections and skin diseases (Schistosome dermatitis and "athletes foot") have been recorded as having been contracted in bathing pools. It is doubtful if the intestinal diseases are important in artificial bathing pools using purified water.

The potential possibilities of infections of the upper respiratory tract and the ear being spread in pools are great, since the water in the pool may be contaminated with the combined washings of membranes of the nasal passages and mouth of every swimmer and it is possible for bacteria from the nose and mouth to be transferred between bathers before ample time has elapsed for the disinfecting process to appreciably diminish the number of bacteria. This is a bacterial hazard which is not indicated by the common bacteriological tests made on swimming pool waters. Moreover, water produces a temporary shrinkage and bleaching of the mucous membranes adjacent to the openings of the sinus, making possible the direct entrance of contaminated water into the sinuses, where there is probably little local resistance to the bacteria. Chilling of the body surface may lower the resistance of the bather. Excessive amounts of chemicals may cause irritation.

Skin infections are probably most often spread by insanitary dressing rooms, walk-ways, and suits and towels.

Sanitary Control of Bathing Pools. There are certain requirements which must be met in maintaining a bathing pool of desirable sanitary quality. It is essential that the bathing place has clean water, controls of the bathing load, and adequate disinfection of the pool water, requires use of the overflow gutters, maintains clean dressing rooms and walk-ways, has showers, toilets, and lavatories, disinfecting foot baths and clean suits and towels, and enforces personal regulations concerning hygiene of the bathers.

Bacteriological Quality of the Water. The present bacteria tests for bathing places make use of the confirmed test for the colon-aerogenes bacteria and the total 37° C.-24 hour count on nutrient agar. The total plate count is indicative of the gross pollution in the pool, while the confirmed test shows pollution from the intestinal tract. The presence of various *Streptococci* and *Staphylococci* should be considered of greater significance than the *Colon-Aerogenes* bacteria because of their association with respiratory and skin infections, and the presence of *Streptococci* in the intestinal tract. Large numbers of *Streptococci* and *Staphylococci* may enter the pool water in discharges from the nose and mouth, and may be washed into the pool from the skin of the bathers. While no standard for *Streptococci* has been developed, the presence of numbers of them should cause concern as to the sanitary condition of the water.

Bacteriological sampling of the pool water is important if a true picture of the sanitary quality is to be obtained. Sampling bottles used for chlorinated pool water should be treated with sodium thiosulfate or some other appropriate anti-chlor to prevent the continuing action of the disinfectant after the sample is

taken. Samples should be taken when there is a large bathing load in the pool, which is the time of greatest hazard in the pool.

The writer has found that sometimes the 24 hour-37° C. count on nutrient agar for chlorine or chloramine-treated water will be low, but 48 and 72 hour counts on the same plates will show many bacteria, possibly due to the disinfecting agent not killing the bacteria in the water, but so affecting them as to inhibit rapid growth on the nutrient media.

Disinfection. A bathing pool disinfectant not only should destroy the bacteria but also should act rapidly, since the interim bacteria are in the water while passing from one bather to another may be very short. Chlorine disinfects more rapidly than does chloramine. Chloramines are not as irritating to the bathers as is chlorine. To obtain the same rate of disinfection, it is necessary to carry about twice as high a chlorine residual when using chloramines as when using chlorine. A sufficient residual of chlorine can be more easily maintained as chloramine than as chlorine. When using ammonia with chlorine, the amount of ammonia should be closely controlled since excessive amounts of ammonia further reduce the disinfecting rate of the chlorine. The chlorine in the water is dissipated while most of the ammonia remains in the water and will accumulate with recirculation if ammonia is added continuously. Also ammonia may be added to the water by washing from the bodies of the bathers.

When chlorine alone is used for disinfection, a residual between 0.3 and 0.6 p.p.m. should be maintained and when chloramines are used the residual should be between 0.5 and 1.0 p.p.m.

Residual chlorine is an important index of the sanitary quality of the pool water and should be checked often by the operator to see that it is within the desirable range. The bathing suit and body of the bather exert a demand on the residual chlorine to such a degree that when a large number of bathers enter the pool the residual chlorine may sometimes be reduced from 0.3 or 0.4 p.p.m. to almost no residual unless the chlorine dosage is increased.

Intermittent disinfection by adding hypochlorite powder to the pool is of doubtful value because a chlorine residual will be absent when it is most needed. Intermittent disinfection should not be used except in very small pools where the bathing load is light.

Bathing Load. The possibility for infections being transferred among the bathers increases greatly with an increase in the number of bathers using the pool. The greater the number of bathers using the pool between turnovers or between fillings the greater the number of bacteria that will be added to the water, and the closer the bathers are together in the pool, the greater are the possibilities of bacteria being transferred from one bather to another.

The bathing load is a desirable inferential index of swimming pool quality. The following formula of Becker is widely used for bathing load determinations:

$$BL=\frac{CM}{T^3}, \text{ in which}$$

BL=Bathing load (daily maximum), C=Capacity of pool in gallons, T=Turnover in hours and M=An arbitrary multiple, for which Becker uses 3.84. Others have modified this to take account of specified conditions at a pool.

Overflow Gutters. The overflow is a means for removing the floating nuisance and contaminating material, and is a place in which bathers can expectorate mouth and nose washings after diving. The overflow is one of the most important factors of a pool. The water level should be such that water can continuously overflow. It has been found that the water leaving the overflow usually contains many more bacteria than the water in the main body of the pool, which indicates that the overflow gutters effectively serve to reduce the number of bacteria in the pool. Some bathing pools use the overflow gutters intermittently. This practice is undesirable and should not be allowed.

Dressing Rooms. Skin infections, such as so-called "athletes foot," are readily spread in dressing rooms. The floors, benches, walkways, etc., should be disinfected daily. Foot baths containing 0.3 to 1.0 per cent available chlorine should be so located that the bathers must pass through them in going to and from the pool; if the strength of the disinfecting solution in the foot baths is not properly maintained, they may become a source of infection rather than a protection and therefore these should be given frequent attention.

Warm water showers provided with soap are essential to a pool. Without warm water showers the bathers will often neglect proper showering before entering the pool. The cleaner the bodies of the bathers before entering the pool, the cleaner will be the pool.

Clean Suits and Towels. Skin diseases are most readily spread through the use of unclean suits and towels. Where possible, the pool management should provide and service suits and towels, disinfecting them after each use. It is useless to insist on a soap and water shower and then permit a bather to put on a suit which has been worn several hours as underwear or a play suit.

Clean suits and towels should be kept separate from those that have been used, and not be passed over counters where dirty suits and towels have been.

Personal Regulations and Supervision of Bathers. Probably the most effective means of controlling the sanitary conditions of a pool is to control the bathers. Personal regulations should be posted regarding a soap and warm water shower bath in the nude before entering the pool, the use of foot baths, the use of toilets, the exclusion from the pool of any person having a skin disease, sore or inflamed eyes, colds, nasal or ear discharges, any communicable disease, or cuts, blisters, and open sores, and prohibiting spitting and blowing the nose into the pool; together with information concerning the risks that may accompany bathing in insanitary pools. The posting of regulations will be ineffective unless they are accompanied by supervision.

Instruction of the bathers and of the pool attendants in personal hygiene and sanitation is important. The life guards and pool supervisors usually have had considerable instruction in the principles of life saving and artificial respiration, but very often are poorly informed concerning the hygiene and sanitation of bathing pools which also should be their responsibility. At many public pools, instruction in swimming and life saving is provided for children. If this instruction included general information on the hygiene and sanitation as they effect the pool, the bathers themselves would help to keep the pool clean and sanitary. They would be more observant of hygienic precautions themselves and for their own protection would see to it that their fellow bathers attempted to maintain sanitary conditions.

Unless the attendants and bathers cooperate in keeping the pool sanitary, other control measures will be only partially effective.

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* From a paper presented to the health officers, sanitary engineers and sanitarians of the North Carolina Public Health Assn.

Frink V-type snow plow widening cut.

Organization, Methods, Equipment and Materials for Snow and Ice Control

PROMPT removal of snow from nearly all highways and the treatment of icy or slippery surfaces to prevent accidents are now well recognized necessities. It is indeed a backward and non-progressive community that does not make provision to keep the roads open and safe for traffic. Foresighted planning to accomplish this, and the selection of the proper equipment to meet local conditions are necessary.

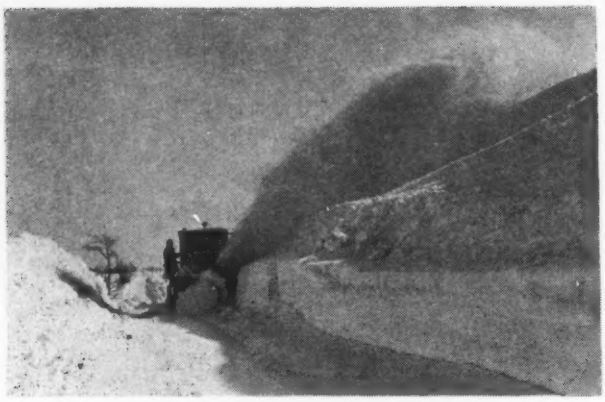
An old colored preacher, taking as his text "And the Lord cured the multitude of their divers diseases," went on to explain that while any old sawbones could cure the malaria, only the Lord could cure the "divers." Snow removal has a certain analogy. Poor organization and antiquated equipment may get through a mild winter with only minor traffic delays and blockades; but when a severe winter comes along, only sound preparation, modern and powerful equipment, and an adequate organization can keep the roads open. Snow or ice storms give no warning; they come on no schedule; preparation must be made in advance and equipment purchased and made ready before storms arrive.

While snow removal in any way costs money, it usually costs less if adequate equipment is used. The purchase cost of snow plowing and removal machinery is not great; the major costs are involved in rental of motive power and the wages of men. A truck with a modern plow, designed for the work it has to do, will accomplish much more in a given time than the same truck with an obsolete plow or one that is on the verge of a breakdown. In a severe winter, new snow plow equipment may pay for itself in truck cost savings alone. A snow loader may pay for itself in truck rental saving in one winter. It is most dubious economy to try to economize by using equipment that is subject to breakdowns or is unfitted for the work it has to do, to say nothing of the financial loss and inconveniences caused to road uses by inability to keep the roads open while repairs to equipment are being made.

Organization and Planning

The first step is the determination of the road system to be cleared, the priorities of the various roads and the establishment of plow routes. In a county or state, the most important roads should be cleared first, and then the others in the order of their importance. In a city or village, important streets should have first attention, followed by the others. In most snow areas, this policy is well recognized and plans based on it already exist.

The number of snow plows, trucks and tractors necessary to the program should be determined and arrangements made for rental of trucks and tractors. There does not seem to be any standard formula for number of plows. Ordinarily enough plows should be provided, in first class condition, to handle a severe and prolonged storm; but seldom are enough provided to keep roads open during maximum storms. Most severe storms are localized and a state can meet emergencies by transfer of units. This is not often practicable for counties and cities, since in the average county a severe storm will affect all roads, though some more so than others; therefore, a county should provide more plows per unit of road length than a state. As for trucks and tractors, what number of extra ones may be needed can usually be hired locally. This must



Frink plow making the snow fly.

be arranged for in advance, as must procurement of men. The highway or street forces are utilized for supervision and direction of the work.

Getting ready for winter weather involves, in addition to providing the necessary snow plowing equipment and arranging for motive power, other kinds of preparatory work. One manufacturer in an excellent booklet, "Plan Now For Winter," lists the following:

1. Service all equipment in late fall and get it ready for the hard winter work.
2. Install snow plow connections on owned and hired trucks and tractors; put in heaters, radios, winter lights and other equipment.
3. Place snow fences.
4. Relocate all motorized summer maintenance and construction units for most effective snow removal work.
5. Add necessary authorized new equipment.

Snow removal work is hard on both men and equipment. Working efficiency and comfort of the former require that heaters be placed in cabs, and that hydraulic or power controls be installed on all snow plows. Equipment should be in the best possible condition. A breakdown several miles out in the country, in the midst of a snow storm and when every unit is needed, is highly undesirable. Two-way radio is an excellent and worth while innovation.

Snow Fence

Snow fence is a highly valuable adjunct; properly placed, it will prevent drifting in many places and will reduce drifting in others. It should not be placed too close to the road; in general, a minimum of about 100 feet is advisable, and in some locations 300 or 400 feet.

Improvements have been made in wood snow fence, making it more effective and durable. Improvements in fence of the Slat and Wire type include the use of 2-inch pickets, giving greater strength, and also greater coverage, since the 2-inch pickets are wider and, even though spaced a little farther apart, still give greater snow-stopping ability; also extra thickness of galvanizing, which lasts longer and is less affected by putting up and taking down. The pressed steel fence, which is durable, fireproof and is easy to put up and to take down, has horizontal slats instead of vertical ones and is claimed to be light in weight so that about a mile of fence can be carried on a 4-ton or 5-ton truck.

Snow Removal Equipment

Requirements for snow removal vary according to depth and condition of snow, type of road and whether rural or urban. On main highways the plows are started soon after snow begins to fall and drifts are not allowed to accumulate; on rural highways there is rarely enough equipment to do this. Consequently drifts form and equipment able to handle deep snow is required. Where the snow is very deep, or is frozen, still another type of plow is necessary. And in cities, where the snow is merely pushed to the side (or to the center) for later removal, a fourth kind of plow is used.

Power requirements likewise vary. The fast truck is used for keeping main roads clear and the plows used are designed for speeds up to 40 miles an hour. Rural roads are plowed with heavier and slower equipment. Biggest drifts require tractor power. Cities use mainly truck or maintenance equipment power.

There are four types of removal equipment—one-way and reversible blade plows, the rotary and the V. The "one-way" blade type is tapered and curved to pick up the snow and throw it clear of the road. These plows are normally operated at high speeds—up to 40 miles an hour. The reversible type blade has less curvature and pushes the snow; it is designed to operate either right or left, and so cannot be tapered.

The "one-way" plow is designed to reach under the snow, raise it and throw it to the sides far enough to avoid the formation of side banks, which encourage later drifting. The design should be such as to insure that the snow is not thrown into the truck radiator or windshield at any rate of speed, but to the right and off the road.

This type of plow is effective and most economical for use on freshly fallen snows not more than 12 inches deep. It is practically standard patrol equipment for improved roads. Usual snow removal practice is to start a fleet of these plows soon after the beginning of a storm and continue the work until the storm has stopped and all roads have been opened. Under average conditions such plows can do about 90% of the plowing on improved highways, with average wind and snow conditions. The "one-way" plow cannot handle drifts for very heavy snows.

The reversible type of plow is used primarily to push the snow to one side or the other, as when heavy slush or light snows are encountered. A bulldozer can be used for the same work but is less efficient; and there are also special types of blades. The reversible plow is primarily a low-speed unit.

One-Way Blade Snow Plows

Desirable features in a one-way plow include the ability to plow close to the road surface; proper curvature to throw the snow out and away from the road; attachments interchangeable with those for V plows; and a provision to prevent damage when the plow strikes a raised portion of the pavement, a manhole cover or other obstruction.

These are some dozen or more recognized manufacturers of one-way plows, but several of these manufacture only a limited line of plows, principally for use with their own motor equipment. Plows are available for trucks of nearly all sizes. With this type of plow, which relies on the curvature of the blade and the speed of travel to throw the snow clear of the road and to open the full width of the traveled way in two trips, and slow moving power is unsatisfactory.

The length of the plow blade is not a safe criterion of the width of road it will clear, since the blade is usually operated at a considerable angle to the path of travel—35° to 45°. Because of this angle, the one-way plow cannot work on the left side of a road, and is not suitable for piling snow.

A one-way plow suitable for a 1½-ton truck will have a cutting or clearing width of about 7 ft. or a little more, with a blade 8½ to 9 ft. long, a height at

the front end of about 22 to 24 in., a height at the back end of 40 to 44 in., and a weight of around 900 or 1,100 lbs. without attachments. Plows suitable for trucks of 2 to 3 tons capacity, will have a clearing width of about 7½ ft. to 8½ ft.; a blade length of about 12 ft. or a little more; a height of 24 to 26 in. at the front and of 42 to 54 in. at the rear; and a weight of 1,250 lbs. or more, without attachments. For 3½-ton to 5-ton trucks, cutting widths are generally 8 to 9 ft.; blade lengths 12 to 12½ ft.; heights, front 28 to 35 in. and rear 4½ to 5 ft.; and a weight of 1,300 to 1,500 lbs., though some units are heavier.

Plows for trucks larger than 5-ton have a clearing width of 9 ft. as a rule, with blade lengths of 12 to 14¾ ft. The height at the front or nose may be anywhere, depending on the size and weight, from 30 to 44 in., and at the side or rear from 65 to 70 in. The weight may vary up to 2,000 or 2,200 lbs.

As a rule, plows will be bought in sizes suitable for trucks on hand or rented. While each size has, to a greater or less extent, its own most effective and useful range of work, it is not desirable to have too many varieties and sizes of plows, for in case of a breakdown on the part of either the plow or the truck, changeover to a spare may be impossible.

Attachments should be so designed as to permit either V or reversible blade plows to be hooked on without loss of time. There are various types of attachments, the selection of which depends upon the type of truck and the make of the plow. In general, the advice of the plow manufacturer may be followed.

Reversible Blade Plows

Reversible blade plows are of especial value in clearing airports, city streets, driveways, alleys, parking lots and similar places where high speed cannot be employed and where the snow must be pushed and piled. They are used with trucks, tractors, both crawler and wheel; and motor graders and maintainers. They should use the same attachments as V and one-way plows, so that in deep snows or in emergencies the former can be used, and in lighter snows the one-way plows can be used with trucks.

As in the case of the one-way plows, there are about a dozen manufacturers. In general all makes of plows follow a similar pattern as regards shape and size, but several of the makers claim special advantages, as tilting or tripping moldboards to prevent damage when striking an obstruction, ease in reversing, ability to plow clean and adjustments for pitch.

In the very small units, which are made for use with ½- to 1-ton trucks (and even touring cars), blades are normally about 8 ft. long and 2 ft. uniform height; for the next larger size trucks (1½- to 2-ton), blade lengths are 8 to 9 ft. and heights 24 in.; for 2- to 3-ton trucks, blade lengths are normally 10 ft, but height is not increased. The largest units have 11-ft. blades, with heights of 30 to 36 in. Weights run from around 900 lbs., with frame attachment for the smallest unit to 2,000 lbs. for the largest.

V-Type Plows

For the heavy work of removing deep snows and drifts, V-type plows are used. The smaller units, designed for 1- and 1½-ton trucks, are effective in rapid removal of light, or even medium snows, while the big units, with 5-ton trucks or tractors can handle almost any requirement. The V plow can be used, therefore, both as a fast unit, throwing the snow clear of the road shoulders and also for slow, heavy work for widening deep cuts and opening big drifts. This type of plow can be used with trucks, tractors and motor graders

or maintainers. It is of particular value in opening unimproved roads, and in leaving a smooth surface on them. On such types of highways there is seldom adequate equipment at hand to keep ahead of the storm, so that plowing is heavier. Also, such roads are often quite high-crowned and the V plow, with absence of side-thrust. is easier to handle on them. Therefore, the V can be considered standard equipment for unimproved roads and reserve equipment for improved roads, in territories which receive a medium to heavy snowfall.

In selecting a V plow for use with a motor truck, one leading manufacturer recommends that the cutting edge width of the plow should be about a foot more than the overall width of the rear tires of the truck; and if the truck is equipped with dual tires, better results may be obtained by removing the outside tires. If this is done, the cutting width of the plow may be about a foot more than the overall width of the inside duals. The nose height of the plow will depend upon the average depth of snow to be removed, but is also a factor of the power and speed of the truck. The following are suggested:

Anderson one-way sidewalk plow with curb climber.

For 1½- to 2-ton trucks, a cutting width of 7 ft. and a nose height of plow of about 27 in.; for 2- to 3½-ton trucks with rear drive and used for light to medium plowing and patrol work, an 8-ft. cutting width and a nose height of about 27 in. For trucks of the same size, with the outside duals removed, when used for medium plowing, a 7-ft. cutting edge and a nose height of 33 in. For 3- to 4-ton trucks, with overall width not more than 7 ft. for medium plowing and patrol work, a cutting width of 8 ft. and a nose height of 33 in. Rear drive trucks of 4 to 5 tons, or four-wheel drive trucks of 3½ to 5 tons, for heavy plowing should use a plow with an 8-ft. cutting width and a nose height of 40 to 42 in. For 5- to 10-ton trucks, for heavy plowing, an 8-ft. cutting edge and a nose height of about 56 in.

Some makers design their V-type plows according to speeds, giving a slightly different shaping for plows to be used at speeds of less than 15 miles an hour than for those that work at higher speeds.

The V plow is generally made by the same manufacturers as the one-way and reversible plows, and in almost every case is so designed that it can be interchanged with these units in similar sizes, the attachments being the same, and changing over usually being a matter of only a few minutes.

V plows are also used with motor graders and maintainers. Most of the grader manufacturers furnish plows to fit their equipment. The heavier motor graders are excellent for clearing heavy drifts and snows. They will travel at 10 to 15 miles an hour and have tremendous tractive power.

The tractors are even more powerful and are able to clear deep and heavy snow. Some of the heavier V plows with crawler tractors will handle deep drifts, even when frozen; tractors are particularly effective in steep and hilly country that drifts heavily with packed snow. In general, tractors, like graders, are most effective on rural and secondary roads where high speed plowing cannot be utilized, either because of lack of equipment or from the winding and hilly character of the terrain, and where heavy, slower work is necessary.

Rotary Plows

Where snow fills in cuts or gullies, or where extremely deep drifts occur, and it is impossible to push the snow off the road, rotary plows will cut through, removing the snow from the road and throwing it clear for a considerable distance — into adjoining fields where these exist. They are of especial value in widening work where heavy banks of snow stand along the highway; or where snow has frozen after being pushed to one side by V plows. They are used also for loading into trucks on city streets, packing the snow more solidly than other types of loaders.

A new development in rotary plow types is the combination of a blade plow or a snow wing with a rotor. The blade plow with a rotary at one end will clear a space 8 ft. wide or a little more and throws the snow some 50 ft. This unit is excellent for airports and for widening or cutting back snow banks. It can be used as a patrol during the storm and for widening after the storm. The wing and rotary combination is primarily intended for widening through deep snow banks. It can slope snow banks and discharge the snow up to 20 ft. from the road; or it can cut the bank back.

Both of these are designed primarily for trucks; the rotor and blade is powered with a Ford motor and is independent, in operation, from the truck motor. The rotor and wing can be furnished either with a power take off or with an independent motor.

Leveling Wings

Leveling wings are attached to trucks and tractors as adjuncts to V snow plows. The wings bevel and trim off the tops of the side banks of snow, carrying this back and spreading it out so as to reduce the tendency to drift. When the snow depth does not exceed a foot or so, the wings may be lowered to the road surface and used as auxiliary plowing blades, thus widening the cleared way. Wings are also valuable for plowing the shoulders where the plow itself cannot well go.

Wings have controls so that they can be swung out or in, raised or lowered as desired. A brace holds the wing from the truck or tractor body, in working position; but when a solid obstruction is hit, as a curb, culvert wing wall or manhole cover, the wing will automatically trip and then return to its former position.

One wing is usually considered sufficient, as the other side of the highway can be "winged back" on the return trip; but in freshly fallen snow, not too deep, the use of two wings—one on either side—permits clearing a space 12 to 16 feet wide and may eliminate the necessity of a return trip.

The best place to mount wings depends somewhat on the type of motive unit and somewhat on the wing itself, but generally it should be mounted well forward. One manufacturer of truck V and blade plows at-

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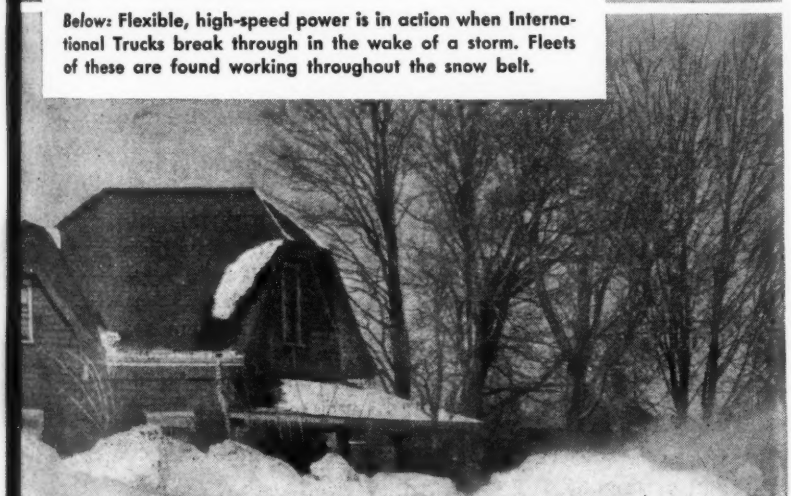
Below: Flexible, high-speed power is in action when International Trucks break through in the wake of a storm. Fleets of these are found working throughout the snow belt.



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Snow loader at Sandpoint, Idaho.

taches wings on rear-wheel-drive trucks, just back of the cab; and on four-wheel-drive trucks, ahead of the cab itself. Another manufacturer recommends rear mounted wings for rear-wheel-drive trucks and front mounted wings for some rear-wheel-drive and all four-wheel-drive trucks. A third recommends front wings because they plow cleaner and do not reduce traction for the truck by permitting snow to fall between the V and the wing, and also states that this arrangement requires less power, piles snow higher and will handle heavier side banks.

Wings are furnished by many of the manufacturers of plows. One manufacturer has fourteen different types, most of which are front-mounted wings, the various sizes having a height at the front ranging from 21 to 24 ins., a height at the rear of 26 to 35 ins., and lengths from 7 to 12 ft. These are especially designed for various sizes of trucks and to work with either "V" type or "One Way" type of plows.

Helps for Snow Plowers

Trucks or tractors for snow removal purposes should have the following: Electric starting, since engines may be stalled in a drift, and getting out and to the starting crank then becomes a major problem. Comfort for the operator, which can be attained with a storm-proof, heated cab, with comfortable seat and arm and back rests. A good wind shield defroster, for clear vision is required. An overhead exhaust pipe, so the monoxide gas will not be blown into the cab, is found on some trucks and is advantageous in deep cuts. Easy controls so that the whole machine responds quickly to the operator's will, and without undue or heavy mental or muscular strain. Desirable factors in motive equipment are ample road clearance, positive traction, and plenty of lights. Head and tail lights, both red and white, and spot lights contribute to safety of motorists and of equipment.

Snow removal must be done under most difficult conditions, including severe weather, heavy work and long hours. The last is necessary both because of the lack of enough skilled men to handle the plows, and also because of the frequent inability to relieve them at the end of an 8-hour shift. Several counties have equipped their snow plows with short-wave radio sets as a better means of control and for keeping in touch with the work. Experience has shown that these greatly increase the utility and value of the unit.

Lifts and Controls

Patrol plows operate at a high rate of speed which requires a quick and sure control of the plow; the larger V plows are heavy and are hard to control by hand-operated mechanism. Power or hydraulic controls are an excellent investment for the following reasons: They make both men and equipment more efficient; safety is greatly increased; by reducing the physical demands on the plow operator, they permit more and better work.

These controls must be reliable; breakdowns at critical moments may put out of use a piece of equipment that is vitally needed. They should be fast, so that a plow or wing can be raised rapidly enough to avoid reducing truck speed. They should be convenient, so that the operator can handle the plow without fatigue and in the comparative comfort of the truck or tractor cab.

Most plows are now available with hand or power hydraulic controls. Plows not so equipped can be changed over and brought up to date easily and with little expense, since equipment is available to fit most installations now equipped with hand controls. Hydraulic controls are not complicated. They consist essentially of a high-pressure oil pump, a few feet of tubing, a valve bank and cylinders. Such an installation provides for any desired combination or sequence of motions. Wear is negligible; cold weather does not affect the operation. Power is normally obtained from a power takeoff (though hand pumps also can be provided.)

Sidewalk Snow Removal

Snow falls on sidewalks as well as on streets and highways; since walks are rarely shoveled early in the morning, pedestrians take to the streets. The cleared portion is usually none too wide—often two cars can pass only with the exercise of considerable care. As a result, walking in the street is dangerous, unusually so for school children.

For this important reason of safety, and also because of the good will that accrues from this work, a considerable number of cities and villages are plowing sidewalks. This is done early in the morning, before business begins and before children start for school. A powered sidewalk plow will travel 6 or 8 miles an hour and in the course of a couple of hours will clear an amazing amount of walk.

Plows have been developed that will climb curbs without trouble and dodge trees and other obstructions; one plow can be raised by controls from the driver's seat to clear a 14-inch high obstruction. Both blade and V plows are used, but most of them seem to be V plows. These generally will clear 3 to 5 feet wide—some are adjustable in width. All of them are useful for a wide variety of other municipal purposes, as for snow removal in parks and around public buildings; also on play grounds and similar places.

Tractors are the favorite motive power because trucks are not made in narrow treads, and the standard width tread is too great for sidewalk work. One of the principal manufacturers of crawler tractors has developed a narrow tread especially for sidewalk plowing; this is useful for many other kinds of municipal work. Another manufacturer has a small tractor that carries a motor mower in the summer, which is exchanged for a snow plow in winter. Wheel tractors are also used for this work, but should be provided with pneumatic tires and tire chains to provide the best traction.

Snow Loading Equipment

In cities, when the snow is plowed to the curbs, the work is only half-done. Banks of snow on both sides of the streets interfere with parking, with loading and unloading, with the collection of garbage and ashes, and with proper drainage along the side gutters; fire hydrants are covered and fire trucks can not reach the

curb. Very few streets are wide enough to permit plowing to a bank or window in the center; and even this has disadvantages.

The solution, of course, is to remove the snow. In some cities where sewers discharge directly to rivers, snow may be dumped into manholes; but where there is a sewage treatment plant, there is risk of much damage. Hauling away is about the only other solution. This involves loading and the employment of trucks or other hauling equipment.

Loading by hand is very expensive, even with relief labor, because of the time wasted by the trucks while being loaded. In fact, with abundance of free labor, hand loading would waste more money in idle truck-hours than the cost of a loader. Quick loading, with the trucks always on the move, is most economical.

A number of snow loaders have been developed that will load even the largest truck in a minute or less. These pick up the snow from the windrow continuously, and discharge into the trucks, which load by driving under the discharge spout. Most of these utilize a spiral type of feed that picks up the snow from the windrow on the street surface—even when the snow is packed and frozen—carries it up an elevator and discharges it into trucks at the rate of as much as 10 cubic yards a minute. Thus one loader can keep a whole fleet of trucks busy and at capacity. Operated by one man, the loader travels along the snow windrow at a speed that depends on the volume of snow in the windrow.

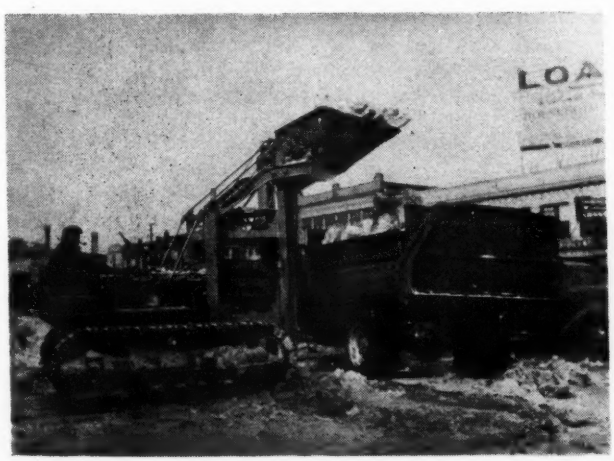
By changing the snow loader boom and replacing it with a bucket loader boom, such a loader can be converted into an efficient machine for handling sand, gravel, earth, crushed stone and other bulk materials, and is thus useful the year around.

From the viewpoint of savings from truck rentals, such a loader will often more than pay for itself in one heavy storm. Meanwhile labor that would normally be utilized in hand loading of trucks can do other needed clearing work, such as at cross-walks and gutters in streets not yet cleared, around fire hydrants, etc.

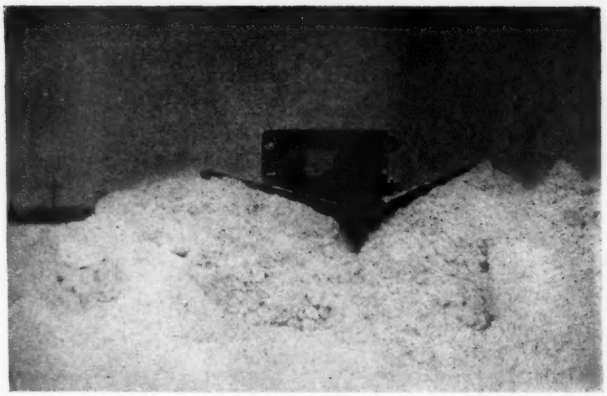
Another type of loader, handling earth in summer and snow in winter, consists of a large scoope bucket mounted compactly on a tractor. The use of the rotary plow as a snow loader has already been referred to.

Ice Control

Cinders and sand are valuable for minimizing dangers from ice. Screened cinders are preferable, though coarse sand is more available and may be used. However in really cold weather, when the ice is hard, the cinder or sand particles do not adhere very well to the ice; they help, but do not render the surface skid-proof. Wind may blow or rains wash the abrasive material off the road surface, or the particles may become coated with ice or frozen snow and thus lose their non-skid value.



A scoop bucket snow loader.



Frink plow and Case heavy-duty 4-speed tractor at Racine, Wis.

By adding calcium chloride or rock salt, the effectiveness of cinder or sand is greatly increased. These chemicals which have the property of melting ice with which they come in contact, when mixed with the cinders and sand, form a fine film of chemical around the particles of grit. When this chemically coated grit is applied to the ice, the particles embed themselves in the ice surface, forming a truly non-skid and safe surface.

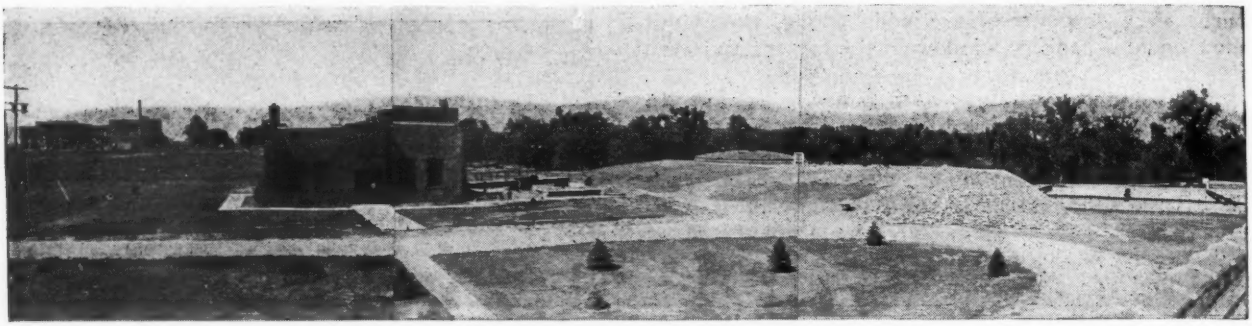
General experience indicates that there are few cases where scaling of concrete pavements can be attributed to the use of such chemicals with abrasives. But salt should never be used alone. A mixture of 1 salt to 25 sand, 2 lb. per square yard, is recommended for general use.

Due to the possible damage to pavement surface through the grinding action of the abrasives, the amount of cinder or sand applied should be as small as possible. The use of calcium chloride or rock salt permits effective ice control with 1½ to 2 pounds of treated abrasive per square yard.

When using calcium chloride in treating cinders and coarse sand, 25 to 50 pounds of calcium chloride should be applied per cubic yard of sand or cinder in flake form or in solution; at the time the abrasives are applied to the highway, a further treatment of 50 pounds per cubic yard of flake calcium chloride should be applied. Spreading by mechanical spreaders is preferable to hand spreading, as the application can be made much more uniformly and excessive amounts of abrasives are not applied. From 15% to 40% saving normally results.

When using rock salt, the sand or cinder should be treated with not less than 100 pounds of salt per cubic yard at the time of application. While placing the stock pile, 50 pounds per cubic yard should be mixed with the abrasive, and 50 pounds per cubic yard additional should be added to the abrasive at the time of application to the icy surface. When the abrasive is stored in bins, the same procedure is followed. When in stock piles, a small additional amount of rock salt should be spread over the exposed surfaces of the pile.

When a heavy layer of ice has formed, the application of salt or calcium chloride to it causes rotting and loosening; removal is then easy with a motor grader, a reversible blade or a bulldozer.



Panorama of the sewage treatment plant, Grand Forks, N. D.

Experiences With Paints at a Sewage Treatment Plant

THIS is a discussion of paints and experiences with different kinds of paint as observed at the sewage treatment plant, Grand Forks, N. Dak. The plant was built in 1935-1936 as a P.W.A. Project and at the end of construction the contractor painted all iron work, except guard railing in the clarifier room, with black asphaltum paint applied directly over the red lead already on the iron when it was delivered to the job. The guard railing in the clarifier room was painted with a black enamel. All woodwork originally was painted with white lead primer and finished with a green house paint on the outside. Inside woodwork in the laboratory was finished brown while that in the clarifier room and aeration room was finished with the green paint used on the outside woodwork. The contractor painted the floor in the basement with a gray floor paint directly on the concrete.

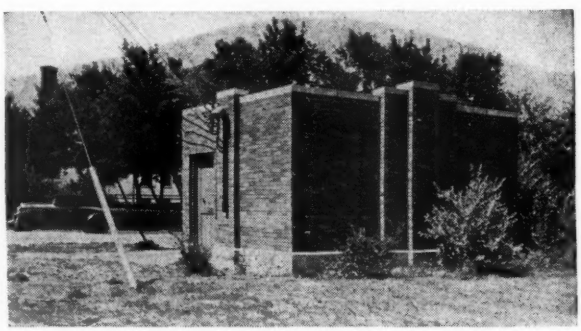
Ironwork requiring paint includes the gas holder on top of the secondary digester, clarifier bridges, scum wiers and V-notch wiers in the clarifiers, roof support girders in the clarifier room, and steel and cast iron piping in the basement and tunnel connecting the digesters with the main building. Woodwork included windows and doors inside and out in the main building, the covers of the grit chamber, bar screen and pipe gallery between the two digesters, and the sludge distributing troughs over the drying beds. Concrete in the basement was the only surface of that kind to be painted.

A variety of conditions limited choice of paints to be used at the plant. For example, sewage gas and moisture has a tendency to break down a paint film. Woodwork in the aerator room was subject to both sewage gas and to mist and water vapor from the sewage being aerated. In cold weather moisture in the air condenses on the window frames and walls and penetrates into the wood frames. Paint applied to outside ironwork, such as the gas holder, must contend with the elements as well as with possible digester gas. Ironwork in the tunnel is protected from the weather but exposed to digester gas in a dry, warm atmosphere. Girders in the clarifier room had to be protected from moisture as well as hydrogen sulphide gas. Woodwork outside had to be protected from weather and some gas except in the case of woodwork in the sludge distributing troughs on the drying beds where the abrasive action of sludge and alternate and frequent wetting and drying might cause trouble.

As mentioned above, all steel work, iron, piping, etc., came from the factory or steel yards painted with red lead. All iron was painted in the early fall of 1936, by the contractor, with black asphaltum paint.

The digester cover showed chalking after six months but was not repainted till after twelve months had elapsed and this time with the same kind of paint: black asphaltum paint. The second painting also showed chalking in five or six months and in 1939 the cover was repainted with a special black asphaltum which stood up better than the former paint used. It was repainted in May, 1940, with black Superlastic paint and at time of writing (August 26, 1940) is still holding its glossy finish.

The guard railing, valve stands, top of clarifier bridge and roof support girders in the inside clarifier room started to peel eight months after the plant was put into operation. This peeling was down to the red lead in about eight months but conditions in the clarifier room were such that painting was prevented before the spring of 1938, at which time all red lead and overlying paint that could be removed with hand tools and sandpaper was removed. The valves and valve stands, guard railing and roof support girders were painted in the spring of 1938 with black Empervo Enamel. The floor of the clarifier bridge was painted with enamel floor paint, in 1938, 1939 and 1940 with the same paint. The girders were repainted in 1940.



Lift station No. 5, intercepting sewer system.

Underwater portions of steel in the clarifiers were repainted with black asphaltum which did not do as good a job as expected and in 1939 was repainted with Special Black Asphaltum which showed good resistance to the sewage as well as a trim appearance. On close examination, however, in the spring of 1940, it was seen that considerable rust and pitting had occurred under the paint. This under-sewage ironwork was then sand-blasted down to new iron and repainted with three kinds of finish coat. One area was painted with metal primer and with Special Black Asphaltum, another was painted with metal primer and with Empervo Enamel, and a third area with two coats of Special Black Asphaltum. At time of writing the Empervo Enamel over metal primer shows least effects of contact with sewage or sewage gases, as well as best appearance and best condition on the surface of the paint of the three kinds experimentally used.

Sludge pipe lines as well as pipes carrying hot and cold water and digester gas in the tunnel were painted with Special Black Asphaltum immediately after the tunnel was finished in the fall of 1938. They appear to be in very good condition at present, which might be expected in that they are protected from the weather and from heavy concentrations of hydogen sulphide in the tunnel atmosphere.

Outside woodwork on windows and doors was painted when the plant was completed, using white lead primer covered with a finish coat of green house paint. This paint soon started to change color and then to peel, and in 1939 was repainted with Moore White Primer and green house paint containing no white lead. The condition at present is quite satisfactory. The woodwork inside of the building and in the clarifier room, was repainted in 1938; condition at present is such that another coat would be advisable. Woodwork in the laboratory, in the basement, and in the shower room is in good shape with two coats of paint applied in 1938.

The concrete floors and stairs in the basement have been painted every year with gray floor enamel. Their condition at present is good.

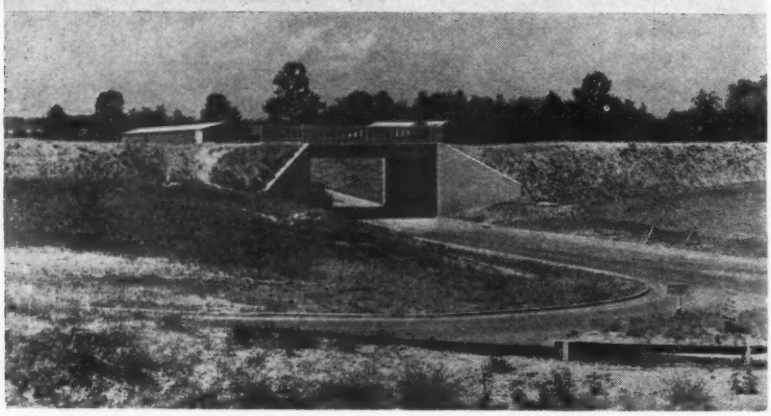
The woodwork of the sludge distributing troughs was painted by the contractor in 1936 with creosote, and in 1937 was repainted with an asphaltum creosote-base paint. Troughs and splashboards were repainted in 1938 and 1939 with Special Black Asphaltum and this year we are going to use Flexiblac Paint instead of the Special Black Asphaltum. Flexiblac paint is the best preserved to date among six different paints put on experimental panels on the sludge troughs last spring.

This is slightly condensed from a paper by Mr. Kleven at the 1940 North Dakota Water and Sewage Works Conference.

Rural Sidewalks in King County, Wash.

By the end of 1940, King County, Wash., will have built 24 miles of rural sidewalks. All have been constructed according to King County standards, with a walk 4 feet wide and 3½ inches thick, of one-course concrete of 1:3:5 mix. For approach entrances to driveways the section deepens to 6 inches. Usually the inside of the sidewalk is placed 2 feet from the property line, only on one side of the county right-of-way, and a modified turnpike section is generally adopted, calling for a shallow drainage ditch between the roadway pavement and the sidewalk.

WPA workers installing 6,000 feet of french drain at Godman Field, Fort Knox.



Cloverleaf underpass at Fort Knox, built by WPA. All traffic moves to the right under the cloverleaf system.

Construction Work at Fort Knox Reservation

THE development of the Fort Knox reservation, which contains 35,000 acres, is now a part of the national defence program. The development work, which is being done mainly by the Work Projects Administration, using 2,200 men from relief rolls in the Paducah region, has included an airport, sheds to house 1,000 pieces of motorized equipment, roads, barracks, mess-halls, tent floors, offices, streets, sewers, water mains, light conduits, gas mains, landscaping and much concrete work.

A field of 1,440 acres of broom sage has been converted into a modern flying field, known as Godman airport, that is now 75 per cent completed. The airport extends one and one-half miles in either direction and the grading of this area required the movement of 1,500,000 cubic yards of earth, with 300,000 cubic yards yet to be moved to establish a proper level. Three runways, one a mile long and two 4,000 feet long, intersect at a common center; one diagonal runway is 3,500 feet in length. All runways are 150 feet wide.

The WPA first installed 35,000 lineal feet of pipe of various dimensions to insure proper drainage of the field. In surfacing the runways, 350,000 gallons of asphaltic oil were spread on 100,000 tons of crushed rock that was produced on a nearby site and supplied as basic runway material. The hangers, and steel and concrete shops are being built under private contract.

An important unit in the development and construction work is the quarry, operating sixteen hours a day on two shifts, with a daily production of 1,200 tons of crushed stone, produced at an average cost of 40 cents per ton. This cost includes labor, supervision, explosives, electric power, gasoline, oil, and other articles. The operating force amounts to 135 men, not including truck drivers. The machinery used includes electric driven primary and secondary crushers, screens, bins, conveyor belts, air compressors, wagon drills, skips and a complete blacksmith shop. The crushed stone is used for all roads, runways, streets and many types of foundations.

In connection with the quarry the WPA operates a concrete block plant that turns out 4,000 blocks of assorted sizes daily. Since July 1938 this plant, employing 50 men on two shifts daily, has turned out 1,000,000 finished blocks.

Among many other uses, the blocks have been used in the construction of basements under 46 sets of non-commissioned officers' quarters and 36 sets of officers' quarters; construction of 80 mess halls; 62 non-commissioned officers' quarters; as foundation material for motorized equipment sheds; and for 1,000 manhole covers.

In a section set aside for the National Guard training camp there are 2,400 concrete tent floors, 16 by 16 feet, each wired for electricity; 44 concrete block mess halls for 100 men, and washrooms of the same material. The tents will care for eight men, and it will be possible to house 19,200 troops in an hour. The objective is to provide the most permanent and sani-

tary type of quarters available. Adjoining quarters, assigned to the Sixth Infantry, are of similar construction.

Under supervision of the U. S. Signal Corps, WPA workers have completed an underground telephone installation system, including 12,300 feet of two cell type conduit and 7,500 feet of main line cable, as well as feeder lines.

Among other accomplishments are five miles of concrete streets, including sidewalks, curbs and gutters; 15,000 feet of sanitary sewers; 40,000 feet of underground power cables, and other services proportionately. Appurtenant work has included landscaping of 200,000 square yards of lawn, setting of 5,000 shrubs and 5,000 trees, the building of three concrete underpasses beneath the Dixie Highway, construction of 40 miles of macadam road, the rehabilitation of 150 World War buildings, and the construction of six heating plants.

The largest of these is the central heating plant which serves the quarters of 72 commissioned officers and their families. It contains a boiler room, coal bunkers, pump room, transformer vault and attendant's quarters. The equipment consists of three tubular boilers and one standby sectional boiler, all of which are stoker fired and automatically controlled. A circulating system of 10,000 feet of wrought steel pipe was laid in concrete and insulated with wool and asbestos fibre. The entire plant accommodates 35,000 square feet of radiation space within the officers' quarters.

All the WPA men are drawn from western Kentucky and brought by special trains from as far west as Paducah. On arrival at the post they are housed in a tent camp and fed in a regular mess conducted by the army, paying 47 cts. a day for food and lodging.

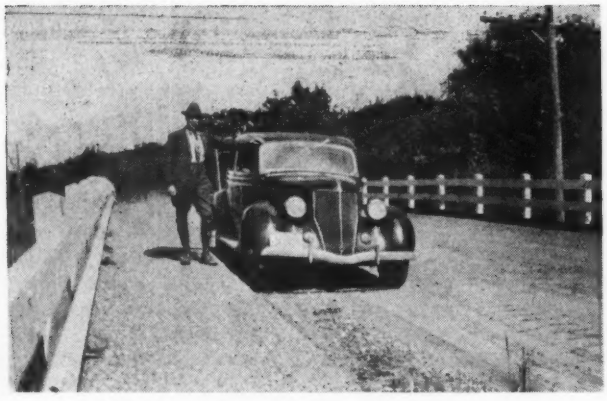
Garbage Collection and Disposal in Houston, Texas

The ordinance requiring covered garbage containers was enforced beginning April, 1939. Food stuffs or kitchen wastes are not segregated from bottles, tin cans and other materials, so long as they are placed in containers with close-fitting covers. Loose papers, pasteboard boxes, hedge clippings, etc., are no longer picked up by the garbage collection units; everything must be placed in a covered container, if it is to be given service by the city. A hedge and grass service is provided, with the material pressed into tubs (no boxes or baskets); bundled hedge, tightly tied, will also be handled.

Collections are made in the business section of the city between 7 a. m. and 9:30 a. m., and at night after 7 p. m., at which time private collectors are permitted to remove garbage from downtown restaurants and hotels. This work is done under the supervision of the city garbage department. Residential collections are either three times a week or twice a week; about 40% of the city gets the more frequent collections.

New truck and trailer units are being added to the collection fleet. These include seven 24-yd. trailers and twenty-one 16-yd. bodies mounted on the cab-forward type of truck. All trucks carry tarpaulins and the loaded portions of the truck must be covered at all times. Surcharging above the water line measurements is not permitted. An unloading device permits removal of any portion of the load as desired.

J. M. Nagle, Director of Public Works for the City of Houston, furnished the above information.



The author on an inspection tour.

A new I-beam bridge.

Organization and Procedure for Maintaining Six Hundred Bridges

By F. C. FREAR
County Engineer, Douglas County, Oregon

IT may be well to present a brief description of Douglas County, one of the largest in Western Oregon, reaching from the summit of the Cascades at an elevation of 6,000 feet to the Pacific Ocean, and with an area of 5,000 square miles and a population of about 24,000. We have over seventy billion feet of standing timber—in fact, the greatest stand of virgin timber of any county in the United States. This timber consists mostly of Douglas Fir with a large scattering of Sitka Spruce, Sugar Pine, Port Orford Cedar, Red Cedar, etc. We also have the Umpqua River which heads in the eastern end of the county near Crater Lake and runs 200 miles, entirely through the county, to the Pacific Ocean. Practically the entire watershed of this county flows into the Umpqua River. Owing to our broken topography, there are many streams to be bridged.

The County Engineer who preceded me reported, in 1919, 3,000 bridges and recommended the elimination by fills of as many as possible. In carrying out this plan we first prepared a small county map and gave each road a name and number; our roads run from 1 to 194. Next, each bridge was logged from the beginning point of each road and a brief outline given in a medium sized field book, giving the bridge number as 1-1.2, 1-1.6, etc., length, height and year erected. A space was then left for the date of inspection which I make personally once or twice each year, using a small pick-axe to dig into caps, posts, sills, joists, etc. After this was done, I had tin plates about 4″ x 12″ painted and numbered to correspond with the numbers in my bridge book, and I then nailed these numbers on each bridge as I made my inspection trip. Our bridge files also are numbered to correspond to the numbers on the structures. Next, I proceeded to make a note in my book of each bridge I thought could be filled, the size of culvert required and the year I planned to make such fill. I also checked the streams during floods for culvert sizes.

As a comparison with the 1919 report of 3,000 bridges, we now have 600, classified as follows: 14 steel bridges, 12 concrete bridges, 2 multi-plate arches, 2 sectional plate arches, 44 covered spans, 72 stockway bridges, and 454 trestles and small truss bridges. Our bridges if placed end to end would reach 6.8 miles; and the covered spans alone required maintenance of ⅞ of a mile of housing and roof. As we are a timbered county, we have many mills and piling operations which haul from 25- to 35-ton loads of logs and piling across these structures. Our bridge fund totals about $40,000 per year and is derived from property and gas taxes; of the latter the Oregon counties receive about 15%, while the State retains 85% for highways.

In maintaining and building our bridges and culverts we have two bridge crews. The large crew, consisting of 8 to 10 men, handles all new and heavy construction, last year built an 800-foot fishing dock on piling at Winchester Bay. Pressure treated, creosoted fir pilings were used for the substructure. The year before they erected a 650-foot bridge consisting of three 150-foot steel spans and 200 feet of trestle approach. The small crew, consisting of five men, repair small bridges and install culverts.

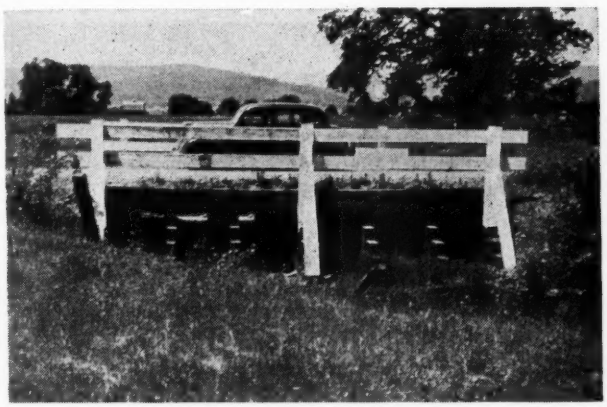
We have been purchasing cull ties at $6.00 per thousand and using them for building box culverts to replace small bridges. We haul them to our yard, and after they become seasoned, we give them a bath in hot creosote; they are then drift pinned together and make a very serviceable culvert. They are generally built from two to four ties high and one-half tie wide, giving 2′ 10″ inside measurement; and from three to four ties long—24′ to 32′.

For the deeper fills we use either corrugated dipped or paved invert culverts or concrete, depending upon the foundation upon which the culvert is laid. In addition to these types we have constructed a number of monolithic concrete culverts. We have also purchased and used old, discarded steam boilers ranging from

three feet to five feet in diameter and 16 feet long, and there is generally enough variation in size so that the larger boiler is placed downstream and the smaller boiler slipped in a few inches, after which the joints are concreted. These boilers make a very substantial culvert for $15.00 or $20.00.

By relocating several sections of road from year to year we are also able to eliminate many bridges. Our longest wooden bridge is 840 feet, over the North Fork of Smith River and consists of an 80-foot Howe truss, covered, and 760 feet of trestle approach. This bridge is 110 miles from our county seat. Our longest steel bridge, here at Roseburg, is 710 feet long, consisting of four 175 foot spans.

We have also erected ten small "I" beam bridges during the past year with reinforced concrete decks; these are generally erected on old abutments and usually run around 20-foot spans with 20 to 24-foot roadways. We have used old "I" beams as well as new ones for these structures.



Box culvert built of cull ties.

In 1938 we erected a wooden trestle 174 feet long with a 24-foot roadway and 4-foot sidewalk. The bents were 29 feet, center to center; for this structure we used 11 lines of 8" x 24" x 30' fir joists to the bent and a 4" x 12" S4S deck, mop coated.

Our biggest job this year on one of our heavy traveled logging roads will consist of a 60-foot steel "I" beam bridge, using five 33-inch "I" beams with a reinforced concrete deck 24 feet in width on the span, and five 21-foot approach bents of wooden construction.

Many of our covered spans are 40 to 50 years old and while still sound are obsolete and far too light. We are endeavoring to replace these as fast as our funds will permit, possibly two or three each year. I survey out all the new bridges of any size and prepare a map and profile outlining the span and approaches required, and then submit the same to the State Highway Bridge Department who prepare the plans and specifications for the bridge and return them to us. The County Court then calls for bids on the materials, and we erect the bridge with our own forces.

Diesel Trucks for Tunneling

With the discovery that diesel-engined trucks give off practically no carbon monoxide exhaust gas, oil-burning trucks have been approved for work on the Midtown Tunnel in New York City. Ten of them are now taking 14-ton loads up a 600-ft., 16 per cent grade from the tunnel to the street.

Soil Stabilization With Emulsified Asphalt

(Continued from page 15)

and placed on the subgrade in accordance with the edge forms and gauge pins, which were set to provide for anticipated shrinkage under compaction. This mix was held in the mixer approximately one and one-half minutes or until thoroughly mixed. Mixer, storage, emulsion, water tanks and other equipment continued moving along the windrow and in an eight-hour day, mixed and laid 300 lineal feet of 7" x 4" x 7" pavement section for a 20' roadway width, or approximatel 667 sq. yds.

The base was undisturbed until the mix had cured to the extent that the surface began to crack and the material was rubbery; then the base was rolled with a two-section sheepfoot roller, with the rollers empty. This operation breaks up the top crust and accelerates the curing and aerating of the base. The base was then allowed to set; and finally rolled with a two-section sheepfoot roller with the rollers filled, this weighing approximately 5 tons. The forms were moved prior to this operation.

The blade grader followed the sheepfoot roller, keeping the base leveled up and true to grade and crown of the proposed pavement. This operation is continued to the satisfaction of the engineer, or until the sheepfoot fails to make a depression; then we used the 10-ton self-propelled roller, rolling the base from edge to center, lapping one-half the width of the roller each time. This operation was performed to imbed all the loose materials left on the surface after the final manipulation of the blade grader. The base was then opened to light traffic—during which period the shoulders and inslopes were completed and hand dressed.

In the placing of the 1½" pre-mix asphalt wearing surface, the trailer-type mixer was installed on a dock constructed near a railroad spur. This location was convenient for aggregate supply and for city water.

The mixer was charged using hand labor, and the trucks used in the hauling of the mixture were equipped with steel water-tight hydraulic dump beds which would haul four batches, or two cubic yards, to the load. The average haul one way was 1½ miles, and two trucks were used for hauling.

The base ahead of the laying of the pre-mixed wearing surface received a tack coat of a mixture of 1:1 emulsified asphalt and water, applied at the rate of 0.3 gallon per square yard. This mixture was applied with hand pump hose and spray nozzle operated by hand labor. The tack coat was allowed to set for sixteen hours or until it had sufficiently dried to eliminate being picked up by the truck wheels in the following operations. The wearing surface was then dumped upon the base between screed strips, which were movable, and brought forward with the laying of the surface. Screed, wooden floats and hand labor were used.

When this material had dried and sufficiently cured, the entire roadway was rolled with a 5-ton roller, rolling from the outside edge to center, lapping each roll one-half the width of the roller. The shoulders along the pavement were then surfaced with crushed limestone rock, graded one inch and less, placed 2¼" thick to provide 1½" compacted thickness. The shoulders and entire pavement were then rolled with a 10-ton roller and the road opened to traffic.

As to date, this road is in perfect condition and seems as though it will be several years before any

maintenance will be necessary The sponsor's cost for this amounted to approximately 50c per square yard; the total cost per square yard, using the above construction methods, was approximately $1.40 per square yard.

Minneapolis Belt Line Highway

(Continued from page 21)

The excavation equipment used included two convertible shovel-draglines of 1 and 1¼-yard capacity, two 60 HP tractors with bull-dozers, two 12-yard scrapers, supplemented part of the time with a bottomless scraper for stripping top soil. All hauling was done by 1½-ton trucks in varying numbers, according to the amount of work under way at the time.

The following is a list of the principal quantities of work performed:

General excavation	2,550,000 cubic yds.
Top soil excavation	350,000 cubic yds.
Peat excavation	550,000 cubic yds.
Gravel surfacing	150,000 cubic yds.
Clay sewer pipe and tile	9,200 lineal feet
Corrugated metal pipe	11,100 lineal feet
Rubble and Ashlar masonry	2,260 cubic yds.
Reinforced concrete pipe	27,450 lineal feet
Seeding	400 acres
Sodding	445,000 square yds.
Trees planted	4,900
Flowering shrubs planted	48,300

The most modern design features were incorporated in the work, all of which has been done according to the latest specifications. Paving, not included in the project, will be placed by the Minnesota Highway Department.

Developed and Potential Water Power of the World

The capacity of the water wheels in the constructed plants of the world, according to estimates made by the Geological Survey, U. S. Dept. of the Interior, was 23,000,000 horsepower in 1920, 29,000,000 horsepower at the end of 1923, 33,000,000 horsepower at the end of 1926, 46,000,000 horsepower at the end of 1930, 55,000,000 horsepower at the end of 1934, 60,000,000 horsepower at the end of 1936, and 64,000,000 horsepower at the end of 1938, an increase of nearly 180 per cent in 18 years. The ten countries leading in developed water power and the installed capacity, in horsepower, of water wheels in each, according to these estimates were as follows: First, United States, 17,949,000; second, Canada, 8,191,000; third, Italy, 6,000,000; fourth, France, 5,400,000; fifth, Japan, 4,800,000; sixth, Germany, 4,000,000; seventh, Norway, 3,000,000; eighth, Switzerland, 2,800,000; ninth, Sweden 2,200,000; tenth, Union of Soviet Socialist Republics, 1,630,000. A statement of the capacity of machinery installed in the different countries, however, does not give a complete picture. For example, in such countries as Canada and Norway, which have abundant water-power resources, the electrical output of the water wheels is greater per horsepower installed than in other countries, such as France and Germany, whose resources are not so great. In Canada and Norway only the best sites are utilized, and at these sites only so much machinery is installed as can be operated throughout a large part of the year with

the water available; whereas in countries where the demand for power is great and the potential water-power resources comparatively small, machinery is installed to use water power that is available for only a small part of the year, power for the remaining period being supplied by steam.—*Journal of the Franklin Institute.*

Cleveland's Nottingham Water Works Plant

CLEVELAND, Ohio, is constructing a new filtration and pumping plant with a capacity of 200 mgd. (The city's largest filtration plant at present has a capacity of 135 mgd.) Water will be brought to the plant through a 10 ft. tunnel nearly 7 miles long, which takes water through an intake five miles from shore in Lake Erie. This tunnel, which will be about 50 ft. beneath the floor of the lake, will be built by contract. The work at the plant is being done with W.P.A. labor. This, known as the Nottingham plant, occupies a plot of 77.6 acres at the intersection of St. Clair Ave. and Chardon Road, adjacent to the N. Y. C. & St. L. R. R.

The tunnel will discharge the raw water into a screened well, from which a conduit will take it to a chemical house, whence, after addition of coagulants, it will flow to a coagulation basin, filter beds, and a 50,000,000 gal. reservoir. Pumps drawing from the reservoir will force the filtered water into two high-service and one low-service distribution systems.

Work was begun in October 1938 and shut down in July 1939; was renewed in March 1940 and it is expected that concrete work on the coagulation basin and filters and on the reservoir will be completed this fall, the excavation having already been finished.

The screen well has been completed and is an especially notable feature of the plant. It is 103 ft. in diameter and 107 ft. deep, requiring the removal of 32,000 cu. yds. of material, of which a considerable amount was shale. In removing the shale about 30,000 lb. of dynamite was used. Charges, running as high as 100 lb. were set off each evening after the men quit work. These broke the shale into large blocks which next day were broken, by means of 14 air-driven rock busters, into sizes small enough to be loaded into cubic-yard buckets, in which the rock was raised to the surface by means of crawler-mounted cranes. Despite the hazardous nature of this work, there have been no serious accidents.

The sides and bottom of the well are lined with reinforced concrete, in which 234 tons of reinforcing steel were used. Twelve carloads of lumber were used for forms and scaffolds, a complete woodworking shop being installed on the site.

Largest Multiple-Arch Dam in the World

The Pensacola dam, recently completed across the Grand River in Oklahoma, is the largest multiple-arch dam in the world. The lake created by it covers some 48,000 acres and has more than a thousand miles of irregular shore line. It is becoming a recreation center for the four adjoining states, with opportunities for sailing as well as motor boating, for fishing and bathing, in a region where such opportunities are scarce. It is proposed to construct a road across its 6,565-foot crest, as well as highways for reaching it.

Head house of Sacramento, Calif., water supply.

The Waterworks Digest

Abstracts of the main features of all important articles dealing with waterworks and water purification that appeared in the previous month's periodicals.

HOW TO FIND ORIGINAL ARTICLES. Key letter at end of each digest refers to name of publication listed in bibliography at end of this section. Numeral indicates title of article.

Real Estate For Quabbin Reservoir

Quabbin Reservoir, furnishing part of Metropolitan Boston's water supply, will cover 38.6 sq. mi. The total water shed that feeds it has an area of 186 sq. mi. and about 81,000 acres of it will be purchased by the Commonwealth. About 242 miles of highways included in the reservoir have been abandoned and 36 miles of new ones constructed. The reservoir occupies some portion of 10 towns, and 4 others with a combined population of 1288 have been abolished altogether. In addition to the above land, purchase has been or will be made of about 18,366 acres on the Ware river watershed and 1,115 acres for right of way for the 24.61 mile aqueduct from the reservoir to Wachusett reservoir. Most of the purchases resulted from voluntary offers by individual owners. The Commission had three independent appraisals made of each property to use as a basis for negotiating. The average purchase price was $106.31 an acre, which overhead brought to $115.48. Thirty-four cemeteries were located within the watershed, 13 of them in the reservoir, and 7,100 bodies are being removed from them to other cemeteries. Most of the bodies, with their clothing and coffins, had completely disintegrated except for the skull and principal parts of the skeleton.[B24]

Steel Bunkers For Activated Carbon

In the operation of Milwaukee's new filtration plant, alum, ammonia and activated carbon are used. The storage of these in steel bunkers has proved satisfactory for the first two but not for carbon. Recently a fire in the carbon bunker had to be extinguished with carbon dioxide gas. To combat such fires it is proposed to keep on hand an additional 200 lb. of carbon dioxide gas, equip the bunkers with explosion-proof doors similar to those used on grain elevators, place indicating thermometers in each bunker, buy more metal cans for storing empty carbon bags in which to carry them to the incinerator, and instal automatic equipment that will flood the bunker with CO_2 if the temperature rises to a fixed point.[A 133]

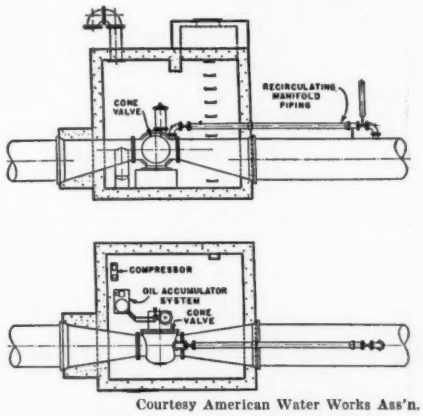
Wichita, Kans. New Well Supply

Wichita is substituting for its old shallow well supply a new supply from wells in the Equus Beds area—alternate strata of sand and clay overlying rock from 150 to 250 ft. deep. This supply contains 1 ppm of iron, which will be removed by aeration over coke trays, lime treatment, coagulation, filtration and chlorination, the plant capacity being 32 mgd. There are 25 wells of the gravel wall type, the hole being 30″ diameter at the bottom, and the casing 18″. These are spaced ½ mi. apart and intercept a front of about 9 mi. perpendicular to the direction of ground flow. Twenty-two of the wells are equipped with 1000 gpm turbine pumps and three with 500 gpm pumps. These discharge into a pipe line 148,900 ft. long to carry the water to the filter plant, the pipe being cement-lined cast iron from 20″ to 48″ diameter. These pipes were designed by the new method approved last year by the American Standards Ass'n.

With this long pipe line, excessive water hammer would be caused by sudden closing of the valve at its lower end, and vacuum and entrance of air by discharge at the lower end exceeding the pumping rate. To prevent these, a number of automatic cone valves are used; six on the supply line, one on each discharge line from the 25 well pumps; also needle-type pressure relief valves at the filtration plant and another in the middle of the well field. There are also air-releases, vacuum-release and manually operated blow-off valves along the line. The cone valves are designed to cut off not less than 75% of the port area with 40% of the piston stroke, and it is calculated that the use of these cone valves would control water hammer to within 20% of the static pressure. The cone valves on the well discharge lines are automatic hydraulically operated, and that on the main line at the filter is float-controlled hydraulically operated. Normal control of the well pumps is centered at the filter plant, and is manual because this is more flexible, permits maintenance of operating heads at a minimum and special operation of the pumps during emergencies.[A 134]

Hydraulic Pump Coupling In Kansas City, Kan. Plant

A new 25 mgd 2-stage centrifugal pump, driven by a 2,000 hp 2,300 volt synchronous motor against a head of 325 ft. serves a part of Kansas City by direct pressure. To permit variable speed control of the pump, the pump and motor are connected by a hydraulic coupling, which offers great operating flexibility and power factor correction of considerable value to the electrical system. This type of coupling was introduced to this country from England in 1930, but is new to the water works



Courtesy American Water Works Ass'n.

Automatic cone valve installation.

field. It has forced bearing lubrication, and speed control is effected by varying the amount of oil in the coupling by means of a small reversible pump which transfers the oil from the coupling to a reservoir or from reservoir to coupling. Two cone valves in the discharge of the pump protect it from severe water hammer.

The water supply (together with additional water not so used) is first furnished by low-lift pumps as circulating water to the municipal electric generating station located nearby, from which it passes to the water purification station. To provide against high water in the river, the substructure is designed to resist full hydrostatic pressure to a point 2 ft. above the operating floor, and the 4 ft. thick foundation mat is strong enough to transmit the hydostastic uplift to the side walls. To prevent moisture entering the switch room, glass block construction is used in place of windows.[A 135]

Typhoid In The Year 1939

Data concerning typhoid fever in the 93 cities of the country which are known to keep the most reliable records are collected each year by the American Medical Association. Those for 1939 are now available and show that the death rate per 100,000 has again decreased, having reached the all time low of 0.65. There has been a decrease **every year since 1930,** when the rate was 1.61. In fact, there has been a steady decrease from 20.54 in 1910, with only an occasional year when the rate exceeded the year previous.

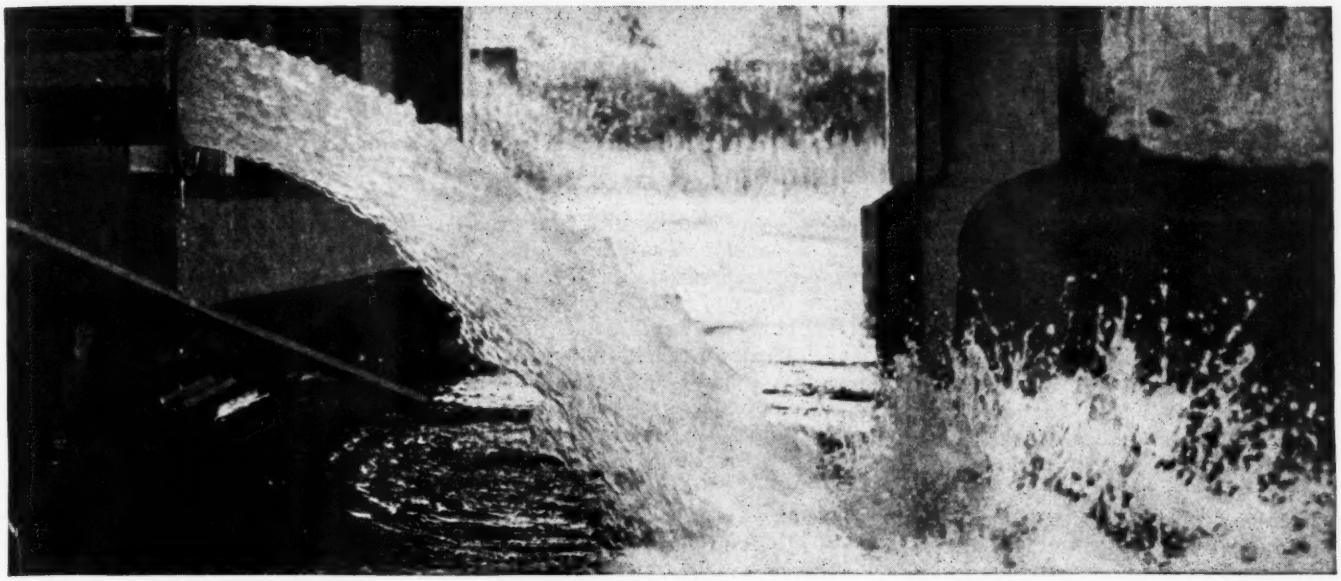
Last year there were no typhoid deaths in eleven of the 14 New England States, in 8 of the 18 Middle Atlantic States, in 1 of the 9 South Atlantic, in 7 of the 18 East North Central, in 1 of the 6 East South Central, in 4 of the 9 West North Central and in 2 of the 11 Mountain and Pacific States. The highest rates for the year were 6.9 for New Orleans and 5.7 for Memphis, each city reporting that one-third or more of the deaths were of non-residents. No outbreak of epidemic proportion was recorded in these cities. As has been quite generally the case, the **lowest rates** were found in the Northern States and in the Pacific States.[A 140]

Automatic Operation of a Treatment Plant at Norwood, Mass.

Iron and manganese are removed from the water in a plant designed to treat 2mgd. Everything in this plant is operated automatically except the high lift pump, and one operator attends to the plant. The float switch in the clear water basin shuts off power to all equipment when the basin is full and also closes the hydraulic valve on the inlet to the basin. The rate of flow through the plant is controlled by rate controllers at the outlet of each filter. Loss of head gages on the outlet of each filter show the hydraulic loss through the filter and indicate when cleaning is necessary. The water level recorder in the clear water basin shows the depth of water available in storage.[J 27]

Records of Distribution Systems

Records of a distribution system should include I. A comprehensive and accurate map of the whole system showing pipe sizes, hydrants and valves. 2. A record of all pipes, date installed, kind of lining, type of fire hydrants, locations of pipes, fittings and dead ends. 3. A compact record of valve locations for field use. 4. Supplementary card records of installation and maintenance of valves, hydrants and services. 5. Original maps and records should be kept in such form as to be permanent and 6. Copies of them for use be easily obtainable. 7. All should



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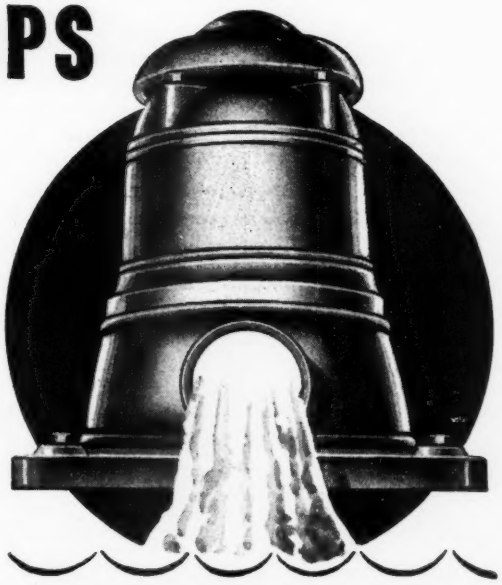

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be kept up to date. A record system may well be based upon the report of the A. W. W. A. Committee on Water Works Practice adopted a few months ago.[F 86]

Laying 48″ Main In Wichita

In laying the more than 20 miles of large pipe in the Wichita project, unusual precautions were taken to produce the conditions which formed the basis of the new design. Trench sides had to be vertical up to the top of the 48″ pipe and the bottom flat and smooth, with bell holes correctly fashioned. Caulking followed closely after pipe laying, and backfilling up to a point 6″ above the center of the pipe had to be firmly compacted. The trench was dug with a trencher, a 3 ft. ladder-type machine being used with extension side cutters to dig the 6 ft. width of trench necessary. Following the trencher, workmen leveled the bottom and cut the bell holes. Where there was seepage water, the trench was extended down grade so that water would drain away from the work and only enough ditch was opened at a time for one 16 ft. length of pipe. The bottom was dug 3″ below grade and covered with gravel and any visible seepage holes in the sides of the trench were plugged with straw. At joint locations a timber frame 3 ft. long and the width of the ditch was sunk about a foot to furnish dry bell holes, being used as the sump for the trench water previous to caulking the joint. Where the amount of water was excessive, well points were used. Where quicksand was encountered near creek crossings, the bottom was paved with a 6″ concrete clab and the pipe cradled in another layer of concrete on top of this. In tamping the backfill, three sizes of hand tampers were used, one with a very short handle for work under the pipe, another with a slightly longer handle, and a long-handled tamper for the final vertical tamping.[E 33]

Removing Incrustation From Wells

Incrustation on well screens is removed at Mattoon, Ill., by use of muriatic acid. This is obtained in 12-gallon carboys and is used full strength, enough being employed to fill a well at least to the top of the screen. It is applied through ¾″ or 1″ garden hose which is inserted so as to reach to the bottom of the well, the upper end being connected to the carboy by means of a glass tee. The hose and tee operate as a siphon after they have been filled by means of a rubber syringe bulb attached to the tee. When enough acid has been applied to fill 1 ft. height of screen, the hose is lifted 1 ft. and another foot added, the object of this being to prevent dilution of the acid as much as possible. The acid is permitted to remain in contact with the screen for 12 hrs. The drop pipe and pump, which of course have been removed before applying the acid, are returned to position 12 hrs. after the acid treatment, and use of the well renewed. As the water at Mattoon goes through a lime-soda softening plant, this compensates for the excessive acid of the water first pumped. Muriatic acid is used for brass or bronze screens but nitric acid should be used if the screens are of iron. Moreover, the chemical composition of the incrusting material should be learned and the acid selected accordingly.[G 31]

Activated Carbon Prevents Algae Growth

Council Bluffs, Ia., has for years had trouble with algae growths in its primary coagulation basins, which it could not successfully eliminate by use of either chlorine or copper sulfate. They noticed that when sufficient activated carbon was applied to the water to darken it no algae growths appeared, and in the spring of 1939 tried coating

the water with activated carbon sprinkled dry directly on the surface. This was not entirely successful because the carbon was blown to one end of the basin by only moderate winds. Later a carbon blanket was obtained by discharging a suspension of carbon horizontally along the surface through a 2″ hose. Application in this way was begun June 5th and continued until the basins were emptied for washing in October. This completely eliminated algae troubles and no more carbon was used than had been used previously in regular operation.[G 33]

Provision for Air Raid Emergencies

Speaking before the Institution of Water Engineers of England, the authors of this paper offered a number of suggestions from air raid experiences. Possibility of quickly isolating breaks in mains by closing valves and bypassing the water is very important. Repairing a 15″ or 18″ main under ordinary circumstances requires the better part of a day, and where gas mains, sewers and other public services have also been ruptured and the site is covered with debris, it may require several days. Instead of lead joints they recommend flexible, screwed or mechanical joints. Special construction for bridging craters before they have been filled, and of connecting fire hydrants at this point if necessary, should be thought out beforehand. Uninterrupted provision of water for fire fighting is especially important and should be kept in mind. Every plant should have at least one portable chlorinating apparatus for treating temporary supplies. When breaks in the mains are repaired, hypochlorite should be placed in the ends of the pipes that are repaired and when water is turned into the new pipe, only one valve should be opened until there has been a few minutes for the water to dissolve the chlorine, when the other valve can be opened. Portable air compressors, power picks, valve-closing equipment and other compressed air tools are timesavers. In each plant, and at several points in large cities, there should be continuously available complete sets of equipment, pipes and appurtenances and tackle ready for loading them into trucks day or night.[D 22]

Bibliography of Waterworks Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

A *Journal, American Water Works Association*
August

130. *c.* New High Pressure Steel Water Supply Line for Colorado Springs. By E. L. Mosely. Pp. 1225-1241.
131. *c.* Pumping and Related Equipment Used on the Mono Craters Tunnel Project. By S. M. Dunn. Pp. 1242-1258.
132. Novel Design Features of the Lansing Water Conditioning Plant. By Claude R. Erickson. Pp. 1259-1309.
133. Tuning up the New Milwaukee Filtration Plant. By James E. Kerlake. Pp. 1310-1320.
134. Improvements to Wichita Water Supply. By R. E. Lawrence. Pp. 1321-1340.
135. New Pumping Station at Kansas City. By R. L. Baldwin and C. S. Timanus. Pp. 1341-1353.
136. Leak Detection. By H. W. Niemeyer. Pp. 1354-1358.
137. The World's Largest Filtration Plant (Chicago). By Loran D. Gayton. Pp. 1359-1380.
138. Experiences With the Palmer Filter Agitator at Olean, N. Y. By Joseph E. Rehler. Pp. 1381-1384.
139. Protective Coating for Steel Water Lines. By Deming Bronson. Pp. 1385-1393.
140. Typhoid in Large Cities of the United States in 1939. Pp. 1394-1407.

D *The Surveyor*
August 16

22. A. R. P. and Water Undertakings. By Granville Berry and Alan Boothman. Pp. 83-85.

August 23

23. British Practice in Dam Foundations. By W. L. Lowe-Brown. Pp. 95-97.

E *Engineering News-Record*
August 29

34. *c.* Driving 85 Miles of Tunnel. Pp. 50-55.

September 12

35. Tuning-up a Large Filter Plant. Pp. 83-84.
36. Building Big Pumps Better Earns a Bonus. Pp. 85-87.
37. Automatic Welding for Water Mains. Pp. 87-88.
38. Cleveland's Huge Screen Well Completed by WPA Workers. P. 89.
39. Baltimore's New Water Tunnel. By Leon Small. Pp. 90-94.

F *Water Works Engineering*
August 28

77. Filter Plant for Rome, Ga. By Carl F. Alexander. Pp. 1070-1072.
78. Jacksonville, Fla., Modernizes its Water System. By Mr. and Mrs. O. Z. Tyler. Pp. 1073-1075.
79. Planning the Distribution System. Pp. 1083-1084.

September 11

80. *c.* Caissons Play New Part in Design of Large Dam. By Charles M. Clark. Pp. 1144-1149.
81. Installation and Care of Services. By Leland G. Carlton. Pp. 1150-1153.
82. Unaccounted for Water. By F. R. Berry. Pp.1154-1155, 1212.
83. Sand Remover for Well Water Based on Centrifugal Flow. By A. H. Jessup. Pp. 1156-1158.
84. Softening Water for St. Paul. By Leonard N. Thompson. Pp. 1159, 1160, 1163, 1164, 1212.
85. Salt of the Earth—a Pollution Problem. By B. F. Williams. Pp. 1165-1167.
86. Developing Records for the Distribution System. By W. Victor Weir. Pp. 1168-1171.
87. Pilot Water Treatment Plant for Study and Research. By George E. Barnes. Pp. 1181-1182, 1185.

September 25

88. New Reservoir for Peekskill. By Geo. P. Wood. Pp. 1228-1231.
89. *c.* Service Connections Complicated by Street Improvements. By Everett C. Handorf. Pp. 1235-1236.
90. Adequacy of Gridiron System. Pp. 1244, 1247.

G *Water Works & Sewerage*
September, 1940

34. Water Softening at Ann Arbor. By H. H. Caswell. Pp. 383-386.
35. The Softening Plant of Ann Arbor. By Louis E. Ayers. Pp. 387-391.
36. Softening the Ann Arbor Supply. By Harry E. McEntee. Pp. 391-400.
37. The "Hyde-Ro Ring." By Ralph H. Hyde. Pp. 401-403.
38. Self-Insurance by a Municipal Water Utility. By J. Arthur Jackson. Pp. 408-409.
39. *p.* Good Public Relations—The No. 1 Asset. By Paul Killian. Pp. 431-432.
40. *p.* Hydraulics in Connections With Water and Sewage Works. By Marion L. Crist. Pp. 433-436.
41. Fire Hydrant Flow Tests. By Henry E. Nunn. Pp. 437-438.

J *American City*
September

27. Automatic Control of Treatment for Well Water. By Bayard F. Snow. Pp. 41-43.
28. Water Treatment—Iron Removal and Softening—Results and Costs. By Walter W. Graf. Pp. 54-56.
29. Sanitation Outside Cities. By Ralph T. Fisher. Pp. 58-59.
30. Water-Supply Interruption. Report of National Board of Fire Underwriters on Break at Pumping Station in Buffalo, N. Y. Pp. 77, 79.
31. Water Rates and Service Charges 1940—Part IX. Pp. 85, 87, 89.

L *Civil Engineering*
September

11. A New Water Supply for Wichita, Kans. By R. E. Lawrence. Pp. 555-558.

P *Public Works*
September

33. Break-point Chlorination. By A. E. Griffin. Pp. 9-10.
34. Designing Water, Gas and Sewerage Facilities for Low Cost Housing Project. By August Sauer. Pp. 20-23.
35. ABC of Taste and Odor Control with Activated Carbon. By E. L. Sigworth Pp. 33, 34, 37-40.
36. Chemical Treatment for the Control of Algae and Weeds. P. 41
7. *n.* Water System Piping Increased by Migration to Suburbs. P. 45.

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September

6. History of Water System of Boothbay Harbor. By Asa D. Tupper. Pp. 101-103.
7. Service Lives of Water Mains in Portland, Me. By Harry U. Fuller. Pp. 103-121.

W *Johnson National Drillers Journal*
July-August

4. Principal Water-Bearing Rocks and Discussion of Porosity. Pp. 1-7, 10.

Y *Pipe Progress*
August

1. *p.* 23 Miles of 42″ and 48″ Mono-Cast Enamelline Pipe Installed at Wichita, Kans. Pp. 1-14.

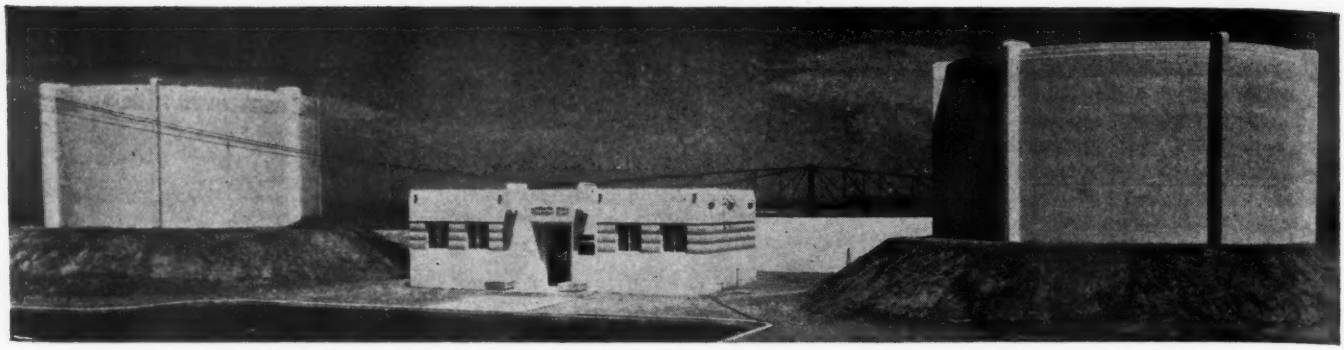
No Liability for Failure of Fire Protection

By the great weight of authority in this country, where a city contracts with a private party or corporation to operate water works for the purpose of furnishing water to the city and its citizens, a property owner cannot hold the city or water company liable for loss by fire, occasioned by the failure of the water company to furnish an adequate supply of water for fire protection. This question has been before the highest courts of a large number of states and in all of them except three, Kentucky, North Carolina and Florida, this rule has been adhered to.

The rulings in the cases following the rule are generally to the effect that there is no privity of contract between the water company and a citizen which will support the action and that the contracting company cannot be charged with a greater liability than the city itself. (Consolidated Biscuit Co. v. Illinois Iowa Power Co., 303 Ill. App. 80, 24 N. E. 2d 582).

Nuisance Damage by Incinerator and Treatment Plant

The North Carolina Supreme Court (Ivester v. City of Winston-Salem, 215 N. C. 1, 1 S. E. 2d 88) in a 4 to 3 decision, reversed a judgment for defendant city in an action to recover damages for alleged injury in taking plaintiffs' real estate and rendering it unfit for habitation by maintaining a sewage disposal plant, an incinerator and an abattoir in close proximity thereto.



Huntington Beach, Calif., treatment plant; Currie Engrg. Co., consulting engineers.

The Sewerage Digest

Value of An Experimental Plant

Preparatory to designing the Hyperion (Los Angeles) sewage treatment plant, an experimental plant was operated for 20 months treating 4800 gpd. This indicated that this sewage was well adapted to physical and chemical flocculation prior to sedimentation, and that one hour sedimentation is ample. The sludge is satisfactorily digested in two-stage digesters with continuous sludge mixing in the primary. Digesting at 85°F gave 12 lb. of dry solids per cu. ft. of primary digester capacity per month, and at 130°F gave 22 lb. Elutriation, at least in connection with mesophylic digestion, indicated a very appreciable saving in chemicals in conditioning the sludge for filtering and was deemed essential for Hyperion sludge. Results from the experimental plant showed that original tentative designs had been unnecessarily liberal; the comparatively small cost of operating this plant "will result in a saving of at least several hundred thousand dollars in the construction of the new Hyperion plant, and the design may be accomplished with a considerably greater degree of confidence than would otherwise have been the case."[C65]

It's Rayne, Louisiana, Not Monticello, Ill.

We are informed by L. J. Voorhies that the photograph that headed the "Sewerage Digest" in our September issue and was labeled "Pump house and laboratory of the Monticello, Ill.. sewage treatment plant" is really one of the plant at Rayne, Louisiana.

How the mixup occurred we can not say. We apologize to both Rayne and Monticello and also to our readers; and thank Mr. Voorhies for informing us of the mistake.

HOW TO FIND ORIGINAL ARTICLES. Key letter at end of each digest refers to name of publication listed in bibliography at end of this section. Numeral indicates title of article.

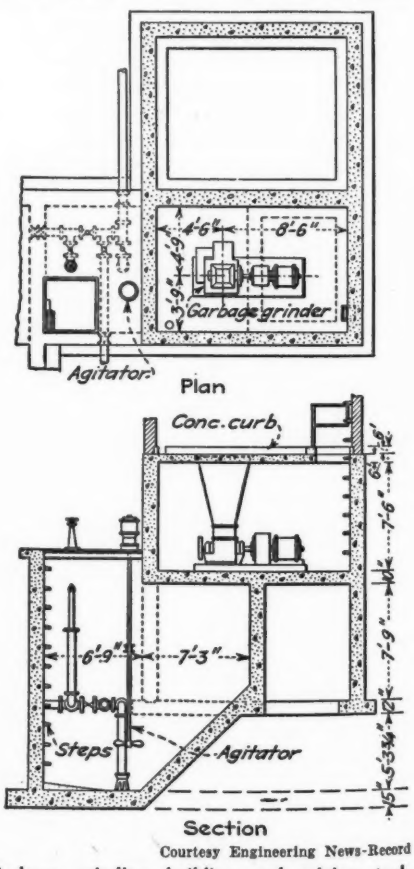
Refuse and Sewage Disposal at Rock Island

Rock Island, Ill., with a population of 40,000, is building a plant for combined digestion of sewage and garbage and incineration of refuse and sludge. It is estimated that the mixed municipal refuse will approximate 30 tons a day. Filtered sludge and ground garbage may approximate 18 tons and the multiple-hearth incinerator for these will have a capacity of 24 tons per day. It is proposed to use the sludge gas for operating a rather extensive pumping plant, which includes pumps with a capacity of 210 mgd for handling storm water, these consisting of five pumps operating by sewage gas and two stand-by pumps by electric motors. Continuous pumping will be done by two gas engine pumps of 3 mgd and 5 mgd capacity and two electric pumps of similar capacity. Because of the large peak demand for gas for pumping during storms, two 500,000 cu. ft. spherical gas holders are provided where gas will be stored under 50 lbs. pressure. Gas will be used for the incinerators, with fuel oil as a standby, and gas will be used for heating the sludge digesters and the buildings.

Two sludge grinders are provided, one at the incinerator building for grinding garbage that may be added to the sewage as it enters the plant or burned in the sludge furnace, the other at the sedimentation tanks for grinding garbage to be added to the settled sludge and pumped with it to the digesters. The grinders are of the swing-hammer type, each rated at 4 tons of green garbage an hour reduced to pass a half-inch screen.[E20]

Filter Flies At Flemington

The Flemington, N. J., filters are sprinkled from stationary nozzles. Late in April 1939 large numbers of white worms about ⅛" long were noticed on the filter stones and walls and in a few days flies had developed in such numbers that it was almost impossible to see or breathe about the plant. Flooding the filters was impracticable. Supt. Allegar had used Carbolineum to control lice in chicken houses, so tried it on the filters, mixing 1 pint with 2 gal. of kerosene and using a knapsack



Courtesy Engineering News-Record

Garbage grinding building and mixing tank details, Rock Island.

sprayer to apply it to the filter surface every morning at the rate of 2 gal. of Carbolineum per acre per day. This kept the flies under control all summer. "The moment the spray came in contact with the larvae or the fly, they just appeared to shrivel up."[X35]

Alum Hastens Sludge Drying

At Aurora, Ill., in 1939 the two-stage digestion tanks were taxed to the point where only 35 days storage was provided in the secondary tank, and this interval between sludge drawings did not give the sludge time enough to dry on the beds. This difficulty was overcome by the use of alum, using it at the rate of 1 lb. for each 85 gallons of sludge, equivalent to 1.4 grains per liter. This was first tried in September and was adopted as regular practice through November and December. The results indicated that under summer conditions the drying time can be as short as 12 to 15 days. With alum, the sludge cake is only 4" thick, but is 8" thick on the beds when the sludge is untreated. Also if rain should fall on the sludge beds, the alum-treated sludge lets the water through and drying is retarded much less than with untreated sludge. The town has adopted this as standard treatment and buys alum in carload lots, which reduced the cost from $31.75. a ton to $24. Two tons are used for treating the discharge onto 10 drying beds.[E 22]

Pre-Heating Digestion Sludge

For treating the sewage from a vacation area of 100 sq. mi. which has a summer population of about 30,000 and winter population of 3,000, a plant is being built near Milford, Ia., of the activated sludge type, which is divided into two units, one small one for winter use only and another of 50% greater capacity for additional summer service. The primary clarifiers are designed for a 1-hr. detention period and a 990-gal. per sq. ft. per day surface area rate. Activated sludge returned to the aeration tank is preaerated for 4 hrs. to reactivate it. Sludge is digested in a heated 30 ft. primary tank and a 38 ft. secondary tank which will be used for storage of sludge in winter. Before being discharged into the digestion tank, the sludge is heated by pumping it through a cylindrical shell and around a pipe coil through which hot water is circulated.[E26]

Complete Plant For A Small Town

The sewage plant at Excelsior, Minn., is unusually well provided with the latest devices, considering its size —1200 population. A comminutor is operated 40 minutes each hour under control of a time clock. A time clock also operates the sludge removers in the clarifiers 20 minutes each hour; and another controls the pumping of the sludge from the clarifier to the digester. All pipes in the control room are painted key colors—red for hot water, blue for cold water, orange for sludge gas, aluminum for the chlorine line, black for sludge lines. An electric control board contains the three time clocks and push-button switches for every piece of equipment in the plant. A panel of pilot lights shows what equipment is operating.[J 17]

Digesting Garbage With Sewage Sludge

Since February, 1939, Lansing, Mich., has been digesting all the city's garbage with the sewage sludge. The daily averages of solids added to the digesters are 19,400 pounds of sewage and 9,430 of garbage, the former being 61% volatile matter, the latter 93%. Without garbage, the gas pro-

duction averaged 100,000 cu. ft. per day (1.3 cu. ft. per capita); with the garbage it averages 231,000 cu. ft. With sewage alone the gas production averaged 8.5 cu. ft. per pound of volatile solids, but is now 11.3 cu. ft., and the percentage of CO_2 in the gas increased from 30% to 36%. Due to increase in gas production, the total solids in the supernatant increased from 0.5% to over 2%, causing foaming in the activated sludge; it is hoped to eliminate this by changing to two-stage digestion.

Trouble is caused by pieces of bones, egg shells and fruit pits, which settle rapidly without digesting and cause clogging of the digested sludge lines. About 15 to 20 cu. ft. of these clogging matters are flushed out of the sludge pipes each day. They also prevent the ball checks in the sludge pumps from seating. The garbage is freed of metal and other trash, including the larger bones, before grinding, but apparently it will be necessary to remove also the matters named either before grinding, or by passing the sludge-borne ground garbage through a grit chamber. The ground garbage is mixed with the raw sludge for pumping to the digester, the sludge diluting the garbage, and no trouble has been experienced with pumping the mixture.[C 66]

Disposing of Garbage With Sewage

Gary, Ind., is building an activated sludge plant in which it will also dispose of the garbage of the city. In studying the entire problem the engineers estimated that the net annual cost of disposing of the garbage by incineration would be $32,940; by incineration with heat recovery the cost would be $25,038; by grinding to sewers and digestion (the plan adopted), $13,565; and by grinding direct to digesters, $14,365. They estimated that digesting the garbage would produce additional gas with an estimated value of $13,000 a year or possibly $19,000.

This plant would necessitate separate collection of garbage and rubbish. The rubbish will be burned in the present incinerator and the garbage hauled to a grinding building near the sewage treatment plant. After removal of bones, metal and other undesirable material, the garbage passes to two ton-ton grinders, from which it is flushed into the sewers. Provision is made for 23 tons of garbage a day with peaks of 75 tons during the summer. Addition of garbage to the sludge will require an increase of air in the activated plant, of 35% to 50% in the capacity of the sludge digestion tanks, and some increase in sludge bed area. It is estimated that it will double the amount of sewage gas and that the value of the additional gas will approximate 8% return on the cost of garbage grinding and additional plant capacity required. As the sewage is very weak it is thought that the addition of the garbage solids will probably improve the operation of the treatment plant.[H 38]

A Cast Iron Interceptor

Staunton, Va., has recently built an interceptor which it seemed advisable to lay in the bed of a creek that passes through the city. This necessitated water-tight joints and sufficient flexibility to permit following the winding course of the stream. Cast iron pipe with bolted bell and spigot joints with rubber gaskets was used. The interceptor was of 14″ and 18″ pipe and 6″ and 8″ iron pipe was used for connections, entering the interceptor through tees or Y branches, the connections being carried horizontally to the bank where a 90° bend formed the base of a stack which was built vertically of cast iron to a point 1 ft. above normal water level. As a number of the existing sewers carry street and roof drainage, the capacity of the interceptor was made three times the dry weather flow and any excess of storm water will discharge through tide gates into the stream. There is 5600′ of cast iron interceptor, and 1900′ of 18″ vitrified clay interceptor where this lies outside of the stream bed.[H 39]

Sludge Sales At Battle Creek

Battle Creek, Mich., has been selling its sludge for fertilizer for several years, both as sludge cake and in the ground form. Last year the former was sold at $4 a ton and the latter at $5 a ton on a dry basis; with an additional charge of $1.50 for delivery inside the city. In 1939 the revenue from selling fertilizer was $1,261.80; in 1938 it was $770.90. The revenue from fertilizer is being placed in a fertilizer fund the object of which is to provide for purchasing drying and grinding equipment. Analyses made through the year show that the sludge contains the following fertilizing elements: nitrogen 4.68%, phosphorous 4.31%, potash 0.38%, lime 6.75%, ferric oxide 12%, humus 55.88%. Using the unit prices of the above elements obtained by commercial fertilizers it is estimated that the value of the plant food solids in the sludge is $19.72 a ton. To make the sludge more attractive to farmers, more rapid dewatering equipment is essential and it is expected that it will be obtained by means of the fertilizer fund.[H 41]

Digesting Night Soil

Less than 1/5 the total municipal area of Singapore has sewerage facilities. Nightsoil is collected in pails, averaging 15,394 pails a day in 1939, and, together with the water used in washing the pails, pumped to a disposal plant. The moisture content was 96.4%, organic content of solid matter was 87.9%. The same plant treated about 6 mgd of sewage, which was passed through sedimentation tanks and suspended matter reduced 56.5%; and the sludge, mixed with night soil, was digested in two-stage heated tanks. During the year 17,700,000 gal. of sludge and 11,300,000 gal. of nightsoil were treated, and the resulting 7,260,000 gal. dried on sludge beds, first being heated to 140°F. for at least 20 minutes to kill hookworm. Digestion gas is used for heating the sludge to kill hookworm, lighting the plant and drying part of the sludge for fertilizer. The amount of gas totaled 8 cu. ft. of gas per lb. of organic matter reduced. The plant produced 633 tons of fertilizer with 26% moisture content from a mixture of sludge dried by heat to 40% moisture and 3-yr. old sludge from trenches with the same moisture content, passed through a rotary drier, ground and screened. The effluent was filtered in 54 percolating filters; one used experi-

mentally as a high-rate filter giving a good filtrate at 195 gal. per cu. yd. of filter stone per day.[D23]

Springfield, Mass. Treatment Plants

Springfield in August put into operation two new treatment plants with capacities of 30 mgd and 3 mgd respectively, giving primary treatment with sludge digestion and sludge drying beds. Among the notable features are the extensive use of aluminum metal for windows, doors, stair railings, gratings and exterior embellishments. The grit chambers are elevated several feet above ground level in order to use all the gravity head available, and the grit from the detritor is discharged by gravity into dump cars that run under the grit chambers, which cars also receive the trash rack screenings. The three comminutors are located in the administration building, and the sewage flows to them through a channel which, inside the building, is covered with a metal plate, and has air diffuser plates on the bottom to keep the sewage fresh and minimize deposits. Sludge gas is stored at 30 lb. pressure in a 36 ft. spherical tank, and is used for heating sludge and buildings and as auxiliary incinerator fuel. The sludge is given double-stage elutriation before conditioning and vacuum filtration. It is estimated that the sludge produced will amount to 14,300 lb. per day, dry weight. The incinerator has 21,000 lb. daily capacity and will be operated on a 5-day basis. In connection with incinerating the dry solids it will have to evaporate 43,800 lb. of moisture.[E23]

Bibliography of Sewerage Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

E *Engineering News-Record*

August 29

21. Garbage Grinding at Gary, Ind. Pp. 35-36.

September 12

22. Aurora, Ill., Sewage Plant Problems. P. 94.

September 26

23. New England's Newest Sewage Works. By Edward J. Cleary. Pp. 38-43.
24. *n.* Copper May Affect Sludge Digestion. Pp. 43.
25. Biofiltration Comes East. Pp. 44-47.
26. Dual Units Solve Resort Sewage Problem. By A. Dale Swisher. Pp. 47-48.
27. Problems in Garbage-Sewage Treatment. Pp. 49-51.

G *Water Works & Sewerage*

September

26. Maintenance of Sewage Pumping Stations. By A. L. Soden. Pp. 417-421.
27. Sewage Filtration With Silica Sand Filters. By Philip B. Streander. Part II. Pp. 422-429.
28. *t.* Hydraulics in Connection With Water and Sewage Works. By Marion L. Christ. Pp. 433-437.
29. *p.* Rotary Blowers in Activated Sludge Plants. By D. L. Dowling. Pp. 440-447.

H *Sewage Works Engineering*

September

38. The Plant That "Steel" Built. By L. R. Howson. Pp. 413, 414, 417, 418, 421, 422, 425, 426, 428.
39. A Sanitary Sewerage System for Staunton, Va. By Raymond C. Regnier, Jr. Pp. 431-434, 446.
40. The Problem of Industrial Waste Disposal. By W. T. Knowlton. Pp. 435-437.
41. From Breakfast Food to Plant Food at Battle Creek. P. 440.

J *American City*

September

20. *p.* Sanitation Outside Cities. Pp. 58-59.
21. Seven Years' Operation Data, Grand Rapids Sewage Works. Pp. 66-67.
22. Sludge as a Fertilizer. By LeRoy W. Van Kleeck. Pp. 73-75.

L *Civil Engineering*

September

7. Seattle's Henderson Street Sewage Treatment Plant. By M. O. Sylliaasen. Pp. 575-577.

P *Public Works*

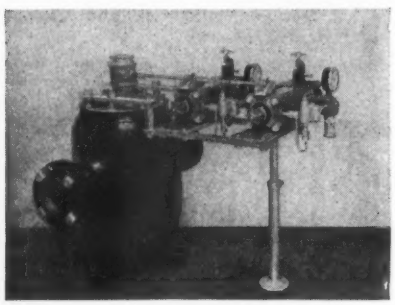
September

44. *n.* Refuse Collection and Disposal. P. 12.
45. Trickling Filters With Open Sidewalls to Improve Operation. By L. J. Voorhies. p. 13-14.
46. Constructing a Complicated Grit Chamber. By E. W. Downward. Pp. 14.
47. Laboratory Studies of Textile Mill Wastes Treatment. P. 14.
48. Constructing a Sewer in Tunnel. By Henry M. Stanley. P. 15.
49. Designing Water, Gas & Sewerage Facilities for Low Cost Housing Project. By August Sauer. Pp. 20-23.
50. Use of Alum in Sludge Drying in Aurora, Ill. Pp. 28, 31.
51. *n.* Refuse Collection and Disposal. P. 31.

Keeping Up With New Equipment

W&T Automatic Duplex Solution Feeders

A completely automatic duplex solution feeder, particularly adapted to chloramine treatment in small water works plants, has been announced by Wallace & Tiernan Co., Inc., Newark, N. J. The unit consists of two automatic hypochlorinators controlled from a single water meter; whenever the meter is operating, the two hypochlorinators automatically apply chemical solutions to the water line in the required proportions for proper treatment. Solutions from the two hypochlorinators can be applied at different points in the water line when it is necessary for one reaction to be completed before the other is begun. For chloramine treatment, one hypochlorinator is used to feed hypochlorite solution, the other ammonia. If desired, the two hypochlorinators can each be used for feeding different



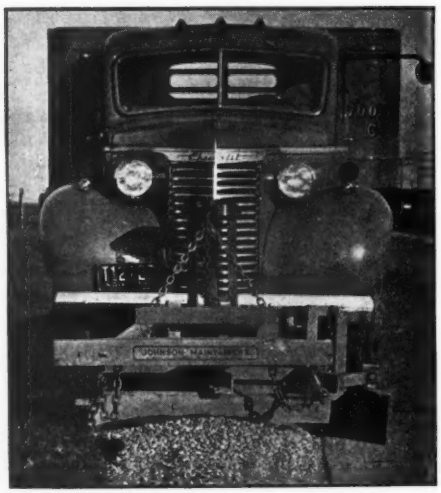
W & T Automatic Feeder

chemical solutions in the water works plant, or for industrial and plant applications.

These hypochlorinators are essentially diaphragm pumps built of corrosion resistant materials. A unique balanced diaphragm principle, employed in all W&T hypochlorinators, operates by balanced water pressures on each side of the diaphragm to minimize the mechanical power required to move the diaphragm. Minimum strains are thus imposed on the diaphragm, allowing longer diaphragm life, and a uniform volume of solution is delivered against pressures as high as 125 lbs. per sq. in.

In the duplex unit, mounting design and the balanced diaphragm principle permit control of two hypochlorinators from a single water meter without placing any appreciable load on the meter. As a result, accuracy of metering is unaffected, and it is unnecessary to resort to any power sources other than available main water pressures. Any type of meter in which a shaft turns in direct ratio to the flow of water through the meter may be used, and the chlorine and ammonia applied will at all times be proportional to the water flow. Variation in dosage is accomplished by varying the length of stroke, for which purpose a control handle and dial are provided on each hypochlorinator, for independent adjustment of each machine. If it becomes necessary to remove one of the two hypochlorinators for any reason, the other unit can be used.

Complete information concerning the new automatic duplex solution feeder may be obtained from Wallace & Tiernan Co. Inc., Newark, N. J.



The Johnson maintainer

A Lubricant for Transits and Levels

A lubricant to which dust does not adhere has been found useful in eliminating "sticking" of clamps, tangent and leveling screws of transits and levels, for surveying work. The lubricant consists of Acheson colloidal graphite suspended in carbon tetrachloride. When applied, the carbon tetra-chloride evaporates, leaving a fine film of graphite serving as a "dry" lubricant. Information on this lubricant is available from Acheson Colloids Corporation, Port Huron, Michigan.

The Johnson Shoulder Maintainer

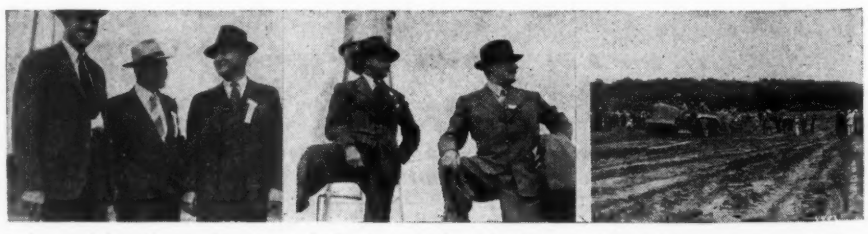
The Johnson shoulder maintainer is a new device for quick and economical maintenance of highway shoulders. It consists of a frame supporting adjustable blades, which are raised, lowered or moved sideways by hydraulic controls. It is used in conjunction with any standard snow plow underframe and mounts on the front end of the truck. It leaves the surface of the pavement free from stones and greatly facilitates maintenance of shoulders in a smooth condition. Quickly attached or detached.

A push-type maintainer is also furnished by the same company. This attaches to the front end of the truck and is handled by hydraulic controls. Full information on both or either from Maintenance Equipment Corp., Fowler, Ind.

Heil Equipment for Cletrac Crawler Tractors

At the Cleveland Tractor Company's factory at Cleveland, on August 26th, the Heil Company held a showing of their complete line of tractor earth-moving equipment; 150 Cletrac distributors assembled in Cleveland, and Joseph Heil, Executive Vice-President of the Heil Company, T. A. Miller, Sales Manager of the Road Machinery Division, Henry French, Chief Engineer of the Road Machinery Division, and the various district managers of the Heil Company, explained the design, construction, and mechanical features of the complete line of machinery available exclusively for use with Cletrac Crawler Tractors.

The Heil Company has under production and is delivering a complete line of bulldozers and trailbuilders, both front and rear pump, for all models of Cletrac Crawler Tractors; two-wheel rear dump hydraulic scrapers; four-wheel hydraulic injection type scrapers; and four-wheel cable scrapers, all in a complete range of sizes; also bottomless drag scrapers, and pushdozers.



Left to right: Henry French, Jack Davies and Joseph Heil of the Heil Co.; B. T. Eagerton and Julius Heller, export sales manager and manager of European sales, Cletrac Co. At right, equipment being demonstrated.

PERSONAL NEWS

The following new appointment as city manager has been reported:
Harold B. Vasey, Montrose, Colo.

The following new appointments as city engineers have been reported:
H. C. Ward, Siloam Springs, Ark.
M. J. Shelton, El Centro, Calif.
Edwin F. Smith, Normal, Ill.
John B. Funk, Brunswick, Md.
A. R. Marquardt, Little Falls, Minn.
Wayne K. Harrison, Scottsbluff, Nebr.
Orlo S. Clark, Baldwinsville, N. Y.
Frank E. Schaeffer, Emmaus, Pa.
Harry McKeehan, Wyoming, Pa.
A. A. McMillan, Sherman, Tex.

The following new appointments as county engineers have been reported:
Ed. Allen, Clinton County, Frankfort, Ind.
W. H. Bryant, Union County, Creston, Iowa.
Earl Pickerell, Grayson County, Leitchfield, Ky.
Geo. W. Haffey, York County, York, Nebr.
Z. M. Flaler, Mercer County, Celina, Ohio.

The following new appointments as water works superintendents have been reported:
John R. Peavy, Mobile, Ala.
C. M. Shaw, Prescott, Ariz.
Floyd A. Hinton, Delta, Colo.
W. H. Goodhue, La Junta, Colo.
Erwin M. Craig, Zion, Ill.
Ross M. Brown, Plymouth, Ind.
Louis C. Ramp, Rensselaer, Ind.
John R. Barnett, Chariton, Iowa.
H. H. Folkens, Rock Rapids, Ia.
J. R. McCullough, Sibley, Ia.
A.C. Gremmels, Crookston, Minn.
C. F. Wimer, Hastings, Minn.
L. W. Lemon, Bonne Terre, Mo.
Henry Redlaczyk, Ronan, Mont.
G. G. Wendt, Falls City, Nebr.
Ray Coffey, Hastings, Nebr.
Russell C. Smalley, Highland Park, N. J.
Seymour Clark, Oneida, N. Y.
George W. Hamlin, Cleveland, Ohio.
W. J. Moore, Eugene, Ore.
John Edling, Schuylkill Haven, Pa.
Chas. L. Fox, Wilkinsburg, Pa.

H. G. McCartney has resigned as City Engineer and Engineer for the Planning Commission of the city of Alexandria, Va., and has opened an office as Consulting Engineer at 3815 Mt. Vernon Ave., Alexandria, Va.

Paul A. Baukson has been appointed City Manager of New Rochelle, N. Y., succeeding Irving C. Brewer who has resigned effective Dec. 31.

William C. Rudd, Eugene A. Hardin, G. Gale Dixon, George L. Bean and William H. Crawford have been appointed to design a filtration plant and water supply improvements for Philadelphia, Pa. John A. Neeson is Director of Public Works.

John T. Woodson, formerly with the Lynchburg Foundry Co., Lynchburg, Va., is now Associate Southern Sales Manager of National Cast Iron Pipe, Birmingham, Ala., handling sales in the Southeastern area.

Civil Service Examinations for Engineers

Open competitive examinations for junior engineers, in all branches of engineering except aeronautical and naval, have been announced. Salary is $2,000 per year. Applications will be received until Oct. 24 from states east of Colorado and until Oct. 28 from Colorado and states west. Age limit is 35; applicants must have completed a 4-year engineering course at a recognized college; examination will be written. Apply to Civil Service Examiners at any first or second class postoffice or to the U. S. Civil Service Commission, Washington, D. C.

Liquid Level Meters

A new 8-page bulletin covering six different styles of mechanical and electric operated liquid level meters has just been published by Cochrane Corporation, Philadelphia. Four electric operated types particularly designed for remote service, including float, differential pressure, and bourdon spiral systems, are included in the bulletin.

Application drawings and technical data are conveniently arranged in sections devoted to each of the various available instruments.

Write Cochrane Corporation, Philadelphia, for copies of the new liquid level bulletin, publication 2990.

Goodyear tire of synthetic rubber "Chemigum"

Bucyrus-Erie 4-Wheel Scrapers

The new Bucyrus-Erie 4-wheel scrapers are described in a 24-page booklet just issued by Bucyrus-Erie Co., South Milwaukee, Wis. This discusses the following features in detail: double-curve cutting edge, balanced weight, positive rolling ejection, controlled depth of spread, etc., with particular emphasis on the way each feature helps give dirt-movers faster time cycles and more dirt. In addition, the new power control units are illustrated and described. Simplified

Bucyrus-Erie scrapers

design, straight-line cable reeving, and careful engineering are discussed. Use of the scraper as a finishing tool is given considerable attention. The bulletin concludes with a table of complete specifications on the four sizes of 4-wheel scrapers. The bulletin is available at International TracTracTor dealers or write to this magazine, and we'll have one sent to you.

Fullers Earth, Filter Sand and Silica Quartz

Tamms Silica Co., 228 N. LaSalle St., Chicago, Ill., is now producing Fullers Earth that is ideal for filtering, bleaching and clarifying lubricating oils, as well as correct grade of Filter Sand available for CL or LcL shipment. They also announce Silica Quartz of natural gravel that meets all waterworks specifications. These products can now be purchased direct for shipment from their Ohio and Illinois mills.

Thickeners, Clarifiers and Agitators

Hardinge Co., York, Pa., has issued a new bulletin, 31-C, describing Hardinge thickeners, clarifiers and agitators. This bulletin contains the first description of the "auto-raise" mechanism, though a number of these units have been in use for the past two years. This device, for use in circular settling tanks, automatically raises the scrapers away from any obstruction or overload of material in the bottom of the tank, preventing breakage or other damage. Many other data are included in this excellent 16-page bulletin, which will be sent on request.

Thawing Frozen Pipes Easily by Electricity

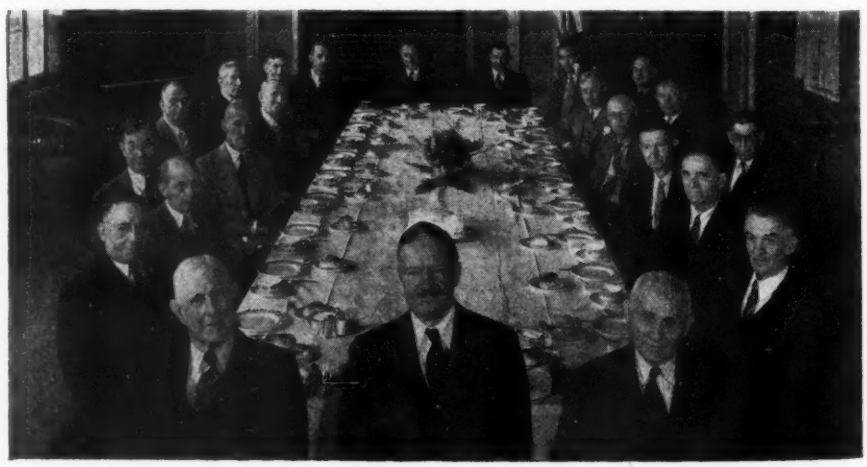
This electric pipe thawer works on 110-220-volt, AC, 60-cycle current, and will thaw frozen water pipes, underground or in any part of a building; hot water systems; radiators; air lines at gas stations; or any other frozen iron pipe. It is available in several sizes and models, weighing 75 to 95 pounds, and can be used also as a welder, thus making it an all-year machine. It will thaw an ordinary service pipe in twenty-five to thirty-five minutes, and will thaw larger pipe, for distances up to 500 feet. Information, thawing advice and descriptive folder from Ralph Fern, 2430 Boulevard Ave., Scranton, Pa.

Small Carryalls

Small scrapers that give savings on every job—counties, mining, airports, farms, ditching, stripping, dams, foundation excavation—with their applications and advantages are described and extensively illustrated in a new Carryall folder published by R. G. LeTourneau, Inc., of Peoria, Ill. This deals with Carryalls in sizes from 3 to 11 yards heaped measure.

The General Supercrane

The wheel mounted crane, manufactured by The General Excavator Co., Marion, Ohio, is described in a new bulletin issued by the manufacturers. On the assumption that a radically new and different machine deserves a new type catalog, General has condensed a "tell all" story into a 12-page bulletin. Chapter headings include: Lifting Capacity, Mobility, Maneuverability, and Stability. The essential facts under each heading are summed up in condensed "Quickfact Summaries." Travel speeds on this unit range up to 10 mph. The manufacturers claim for the new unit—rated at ¾-yd. 15 tons capacity—load ratings of 5,000 lbs. at 50-ft. radius, in 360-degree "full circle" operation. Working views of the machine show typical operations as a crane, clamshell, dragline, pullshovel, and piledriver.



Luncheon given by Pittsburgh Equitable Meter Co. in honor of 50 years of service by Joseph Klein. In foreground are Horace Chrisman, 52 years in service, Col. W. F. Rockwell and Mr. Klein.